

حمل الآن

مجاناً وحصرياً

المراجعة رقم (1)

اختبار شهر ابريل



Test

1

Answered

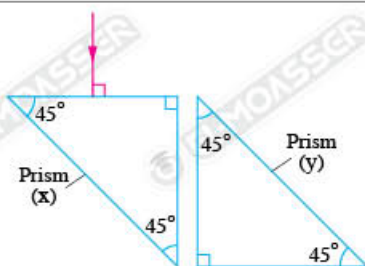
Choose the correct answer (1 : 12):

- 1 Which of the following colors of visible light when passing through an aperture with dimensions of 10^{-5} m has the most noticeable diffraction?

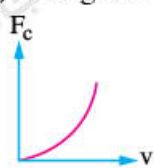
(a) Red (b) Yellow (c) Green (d) Blue

- 2 In the opposite figure, there are two reflecting prisms (x) and (y). When the light ray emerges from prism (y), its path will change by an angle of

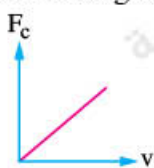
(a) 180° (b) 45°
(c) 90° (d) 0°



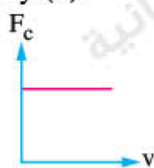
- 3 A body undergoes a uniform circular motion along a circular path with a constant radius. Which of the following graphs represents the relationship between the centripetal force (F_c) acting on the body and its tangential velocity (v)?



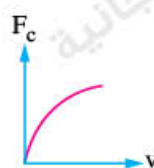
(a)



(b)



(c)



(d)

- 4 The wavelengths of a light ray in two media x and y are $5500 \text{ \AA}$ and $4000 \text{ \AA}$ respectively, then the critical angle between the two media equals

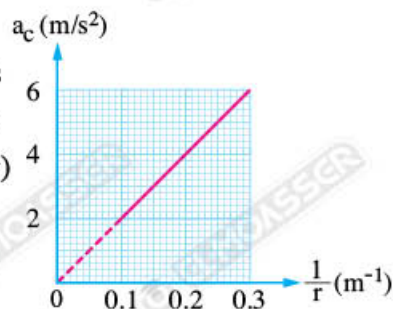
(a) 11.43° (b) 43.11° (c) 46.66° (d) 89.46°

- 5 If the distance between the center of the first bright fringe and the center of the central fringe in Young's experiment is 2 mm, so the distance of the center of the third dark fringe from the center of the central fringe is equal to

(a) 2 mm (b) 5 mm (c) 6 mm (d) 7 mm

- 6 A body moves with the same speed in several horizontal circular paths of different radii and the opposite graph shows the relationship between the centripetal acceleration (a_c) and the reciprocal of path radius ($\frac{1}{r}$), so the tangential velocity (v) with which the body moves is equal to

(a) 4.47 m/s (b) 5.58 m/s
(c) 3.13 m/s (d) 9.8 m/s





- 7 A light ray falls with an angle of incidence ϕ on one of the faces of a triangular prism whose apex angle is 75° and its refractive index is $\sqrt{2}$, and emerges tangent to the opposite face, so the value of ϕ is

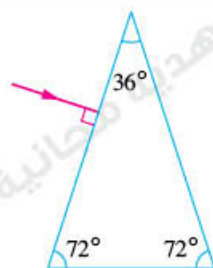
(a) 0° (b) 30°
(c) 45° (d) 60°

- 8 Two bodies with masses 8 kg and 20 kg, and the distance between their centers is 0.2 m. If you know that the universal gravitational constant is G, then the gravitational force between them in newtons equals

(a) 800 G (b) 4000 G
(c) 400 G (d) 8000 G

- 9 The opposite figure represents a light ray falling on one of the faces of a triangular prism whose material has a refractive index of 1.8, so the number of total internal reflections inside the prism is

(a) 1 (b) 2
(c) 3 (d) 4



- 10 In Young's double-slit experiment, when increasing the intensity of the used light, the distance between the center of the central fringe and that of the first dark fringe

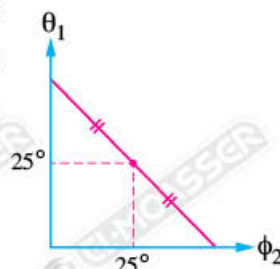
(a) increases (b) decreases
(c) vanishes (d) doesn't change

- 11 An object with a mass of 6 kg moves around the center of a circle with a circumference of 10π m at a uniform speed of 10 m/s, so the centripetal force acting on the object is

(a) 50 N (b) 20 N (c) 120 N (d) 100 N

- 12 The opposite graph represents the relationship between the first angle of refraction (θ_1) and the second angle of incidence (ϕ_2) for a light ray passing through a glass triangular prism, so the apex angle of the prism equals

(a) 25° (b) 45°
(c) 50° (d) 60°



Answer the following questions (13 : 15):

- 13** What happens when a beam of parallel rays of white light falls on a triangular prism adjusted in the minimum deviation position?

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- 14** A light ray travels through an optical fiber as shown in the opposite figure, explain why:



- (a) The direction of the beam does not change at each of points S and P.
- (b) There is total reflection at each of points Q and R.

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- 15** A body weighs 45 N at the Earth's surface. Calculate its weight at a height above the Earth's surface equal to a quarter of Earth's diameter.

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Test

2

Answered

Choose the correct answer (1 : 12):

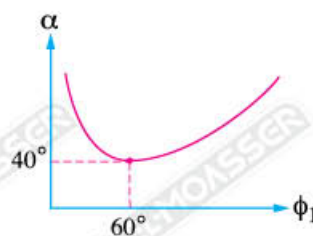
- 1 As the differences in temperature between air layers near the Earth's surface decrease, the probability of the mirage phenomenon occurring

(a) decreases (b) increases
(c) does not change (d) cannot be determined

- 2 The fringe adjacent to the central fringe in Young's double-slit experiment

(a) is always bright
(b) is always dark
(c) has a type depending on the medium
(d) has a type depending on the wavelength of the used light

- 3 The opposite graph represents the relationship between the angle of deviation (α) of a light ray passing through a triangular prism and the angle of incidence (ϕ_1) of this ray on one of the prism faces, so the apex angle of the prism and the refractive index of its material for the incident light, respectively, are

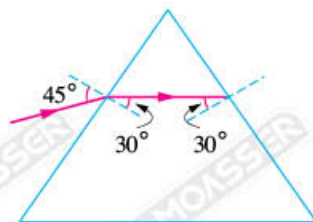


(a) 60° , 1.5 (b) 80° , 1.45 (c) 75° , 1.5 (d) 80° , 1.35

- 4 At what approximate height above the Earth's surface does the strength of the Earth's gravitational field decrease by 1% compared to its value at the Earth's surface?
(Given that: $R = 6400$ km)

(a) 60 km (b) 64 km (c) 30 km (d) 32 km

- 5 The opposite figure represents a light ray passing through an equilateral triangular prism whose refractive index is $\sqrt{2}$, so the value of the angle of deviation for the light ray is



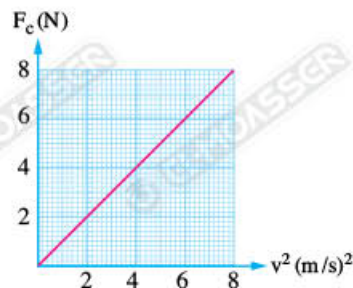
(a) 30° (b) 45°
(c) 55° (d) 60°



- 6 If you know that the acceleration due to gravity on the surface of the Moon is one-sixth of the acceleration due to gravity on the surface of the Earth, then the ratio between the universal gravitational constant on the Earth's surface and the universal gravitational constant on the Moon's surface, respectively, equals

(a) $\frac{1}{6}$ (b) $\frac{1}{3}$ (c) 1 (d) 6

- 7 The opposite graph represents the relationship between the centripetal force (F_c) acting on a body of mass 2 kg moving in uniform circular motion and the square of the linear velocity (v^2) with which the body moves, so the radius of the circular path in which the body moves equals



(a) 0.2 m (b) 0.5 m (c) 2 m (d) 4 m

- 8 If the speed of light in air is 3×10^8 m/s and in another medium is 1.33×10^8 m/s, the critical angle of that medium with air equals

(a) 26.32° (b) 32.26° (c) 63.68° (d) 68.63°

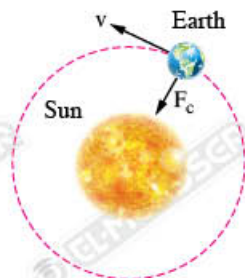
- 9 The ratio between the first angle of refraction and the angle of emergence in a triangular prism in the position of minimum deviation ($\frac{\theta_1}{\theta_2}$) is

(a) greater than one (b) less than one (c) equal to one (d) not determinable

- 10 In a double-slit experiment, a student used a laser beam with a wavelength of 632.8 nm and placed the screen for receiving the interference fringes at a distance of 1 m from the double-slit barrier, so he found that the distance between the center of the first bright fringe and the center of the central fringe was 3.2 mm, hence the distance separating the two slits is approximately

(a) 19.8 mm (b) 198 μm (c) 50.6 mm (d) 506 μm

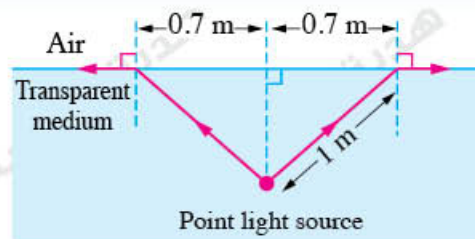
- 11 The opposite figure expresses the motion of the Earth around the Sun in a circular path, so the angle between the directions of the centripetal acceleration and the centripetal force (F_c) is equal to



(a) 0° (b) 90°
(c) 180° (d) 270°

- 12** The opposite figure shows some light rays emitted from a point light source placed inside a transparent medium, so the refractive index of this medium is

- (a) 1.4 (b) 1.7
(c) 1.8 (d) 2



Answer the following questions (13 : 15):

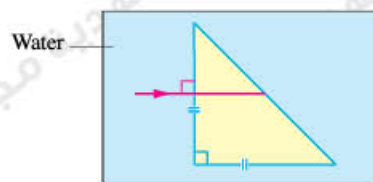
- 13 Explain:** there is no essential difference between the phenomena of interference and diffraction of light.

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- 14** In the opposite figure:

Trace the path of the incident light ray till it emerges from the prism, where the critical angle of the prism's material with air is 42° and the absolute refractive index of water is 1.33.



.....

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- 15** When whirling a stone attached to the end of a string in a horizontal circular path at constant speed. **What** is the direction of the force acting on it that keeps it moving in its circular path? **What** is the direction of the stone's motion at the instant the string breaks?

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Answers of April Tests



Answers of Test 1

1

Question no.	1	2	3	4	5	6	7	8
Answer	a	d	a	c	b	a	c	b

Question no.	9	10	11	12
Answer	c	d	c	c

13 Light emerges dispersed into the seven colors of the spectrum.

14 (a) Because the light ray is incident perpendicular to the interface.

(b) Because the ray is incident from a medium with higher optical density onto the interface between the two layers at an angle of incidence greater than the critical angle.

15 $r_2 = r_1 + h = R + \left(\frac{1}{4} \times 2R\right) = \frac{3}{2}R$

$\therefore w = mg$

$\therefore g = G \frac{M}{r^2} \quad \therefore w = G \frac{mM}{r^2}$

$\therefore \frac{w_1}{w_2} = \frac{r_2^2}{r_1^2}, \quad \frac{45}{w_2} = \frac{\frac{9}{4}R^2}{R^2}$

$\therefore w_2 = 20 \text{ N}$

Answers of Test 2

2

Question no.	1	2	3	4	5	6	7	8
Answer	a	b	d	d	a	c	c	a

Question no.	9	10	11	12
Answer	b	b	a	a

13 Because both of them are wave phenomena resulting from the superposition of waves.

14 The refractive index of the prism:

$n_1 = \frac{1}{\sin \phi_c} = \frac{1}{\sin 42} = 1.49$

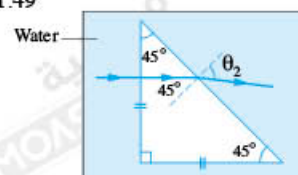
In water : $\sin \phi_c = \frac{n_2}{n_1} = \frac{1.33}{1.49}$

$\phi_c = 63.2^\circ$

$A = \theta_1 + \phi_2$

$45 = 0 + \phi_2$

$\phi_2 = 45^\circ$



By comparing the second angle of incidence (ϕ_2) to the critical angle between the prism material and water (ϕ_c) we find that:

$\phi_2 < \phi_c$

$\therefore$ The ray gets refracted and emerges from the prism by an angle θ_2

Applying Snell's law:

$\therefore n_1 \sin \phi_2 = n_2 \sin \theta_2$

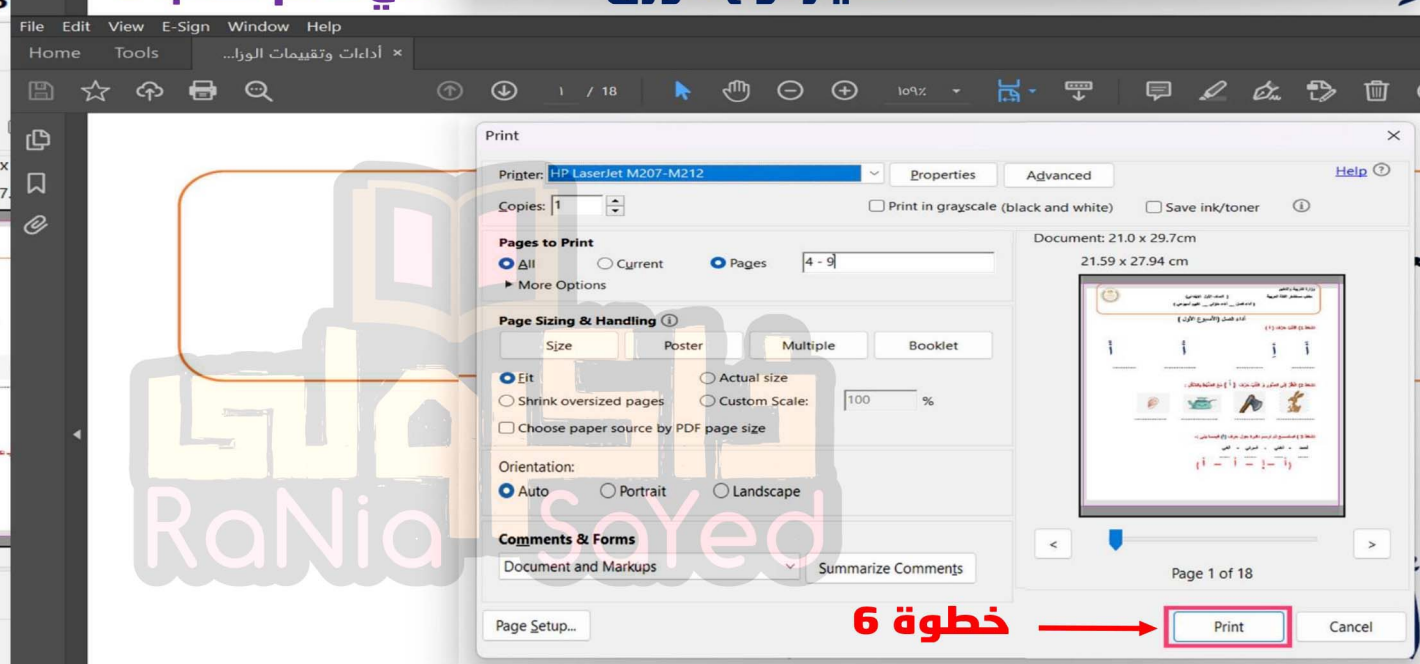
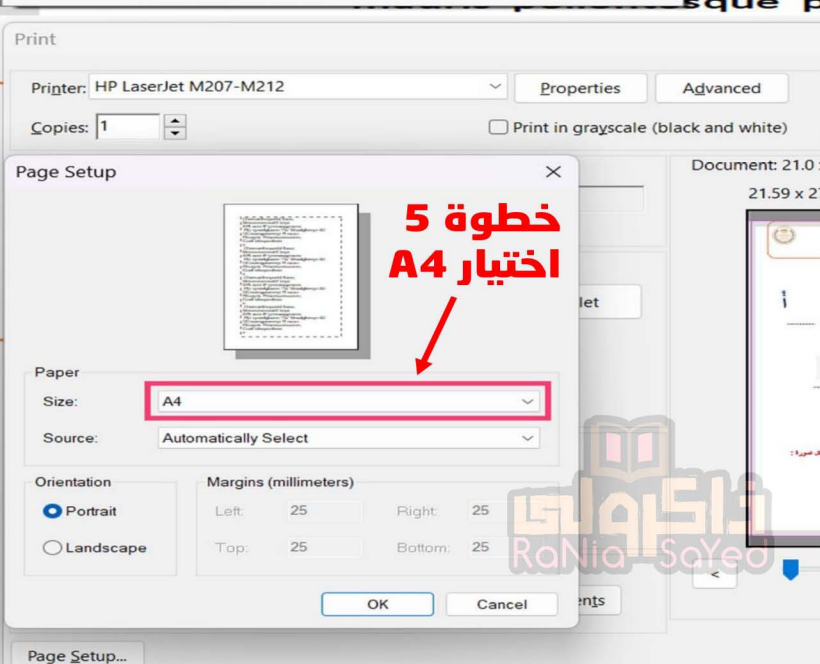
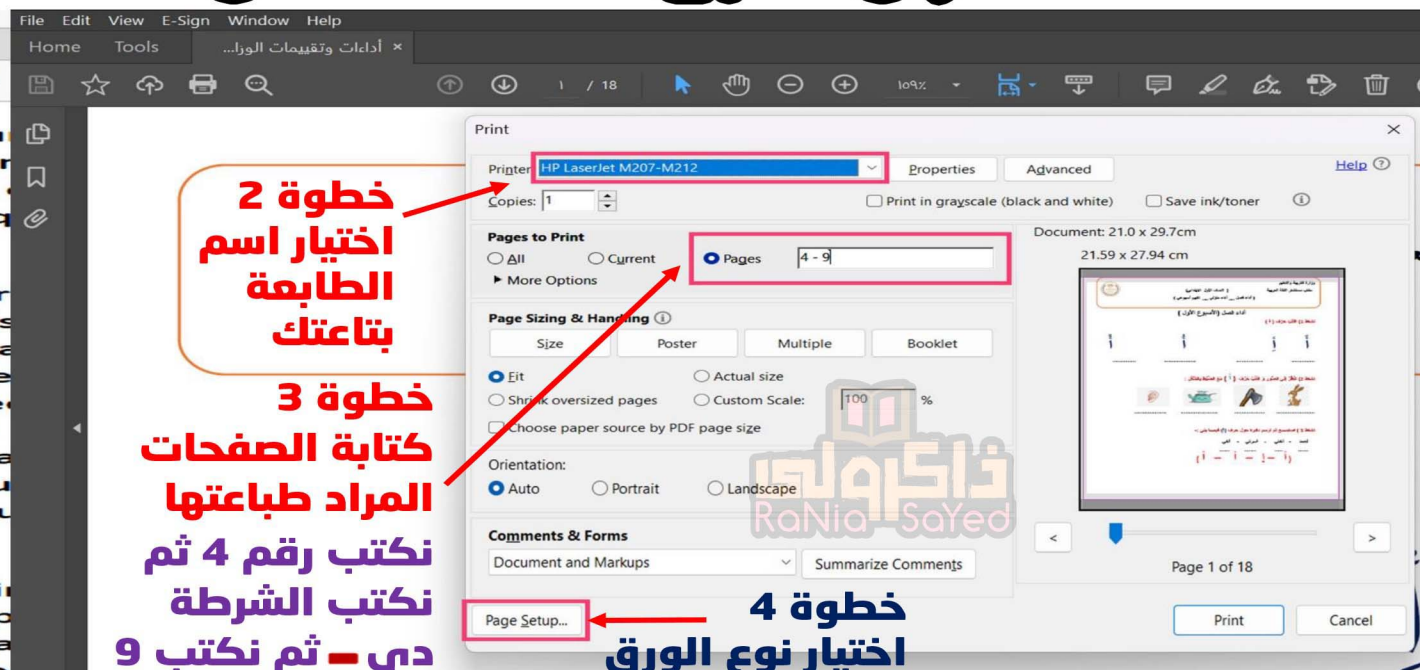
$\therefore 1.49 \times \sin 45 = 1.33 \times \sin \theta_2$

$\theta_2 = 52.39^\circ$

15 • The force that keeps the stone in its circular path acts in a direction perpendicular to the direction of its motion, toward the center of the circular path.

• At the moment the string breaks, the stone moves tangentially to the circular path at the point where the break occurred.

كيفية طباعة صفحات معينة من ملف معين مثلا ازاي نطبع الصفحات من صفحة 4 الى صفحة 9



حمل الآن

مجاناً وحصرياً

المراجعة رقم (2)

اختبار شهر ابريل



Questions ?

Chapter

3

Lesson 2

Answered

Properties of Light

- Interference of Light
- Diffraction of Light

Interactive test



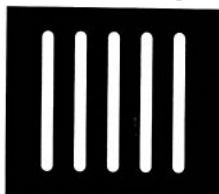
First

Multiple Choice Questions

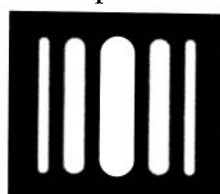
Questions signed by * are answered in detail.

► Light interference

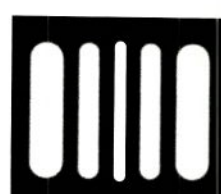
- The interference of light results from
 - the bouncing of waves
 - the deviation of waves
 - the superposition of waves
 - the change of the speed of light
- The double-slit in Young's double-slit experiment works as two coherent light sources, for which coherence means that the two waves formed from the double-slit are
 - in phase
 - out of phase
 - having the same speed
 - having different speeds
- In Young's double-slit experiment, the widths of interference fringes **don't** depend on
 - the distance between the two coherent sources
 - the distance between the double-slit barrier and the observation screen
 - the wavelength of the used light in the experiment
 - the distance between the double-slit barrier and the light source
- In Young's double-slit experiment the distances between the interference fringes decreases when
 - using a light of high intensity
 - decreasing the distance between the two slits
 - increasing the distance between the two slits
 - increasing the wavelength of the used light
- Which of the following figures represents the interference fringes formed on a plane screen in Young's double-slit experiment?



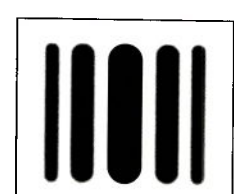
(a)



(b)

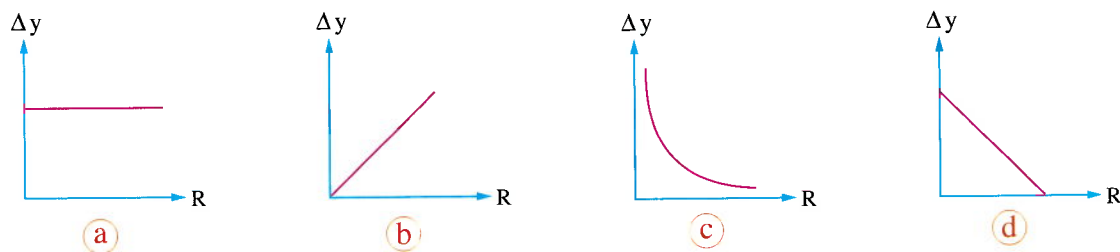


(c)



(d)

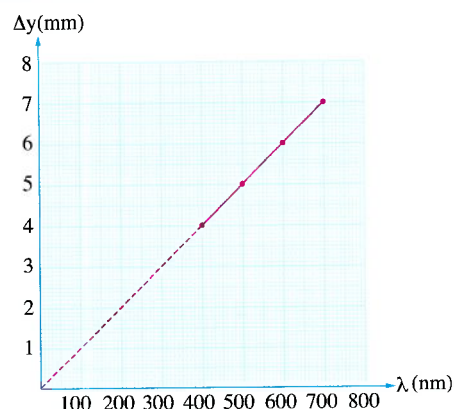
- 6 In Young's double-slit experiment, which of the following graphs, represents the variation of the distance between the center of the central fringe and the center of its following bright fringe (Δy) versus the distance between the double-slit barrier and the screen (R)?



- 7 In Young's double-slit experiment, when increasing the intensity of the used light, the distance between the center of the central fringe and that of the first dark fringe
 (a) increases (b) decreases (c) vanishes (d) doesn't change

- 8 In Young's double-slit experiment, the separation distance between the two slits was 10^{-4} m and the distance between two consecutive fringes of the same type was found to be 3.75 mm when they appeared on an observation screen at a distance 0.75 m from the double-slit barrier, so the wavelength of the used light equals
 (a) 5000 Å (b) 5400 Å (c) 6000 Å (d) 6400 Å

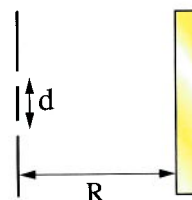
- 9 The opposite graph shows the variation of the distance between the center of the central bright fringe and the center of the first bright fringe (Δy) versus the wavelength (λ) of the used light in Young's double-slit experiment, so if the distance between the observation screen and the double-slit barrier is 1 m, the distance between the two slits (d) equals
 (a) 10^4 m (b) 10^{-4} m
 (c) 10^2 m (d) 10^{-2} m



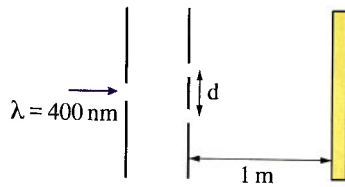
- 10 * In Young's double-slit experiment, if the distance between the two coherent sources was 1.6 mm and the interference fringes were formed on a screen at a distance of 60 cm from them such that the center of the third bright fringe was at 0.6 mm from the center of the central fringe, then the frequency of the used light equals
 (Given that: the speed of light in air = 3×10^8 m/s)

- (a) 4.08×10^{16} Hz (b) 5.63×10^{14} Hz (c) 4.74×10^{12} Hz (d) 7.08×10^{11} Hz

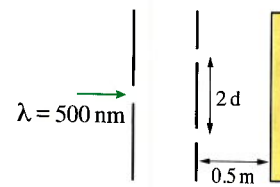
- 11 In Young's double-slit experiment that is represented in the opposite figure, if a monochromatic light of wavelength λ is incident on the double-slit where $R = 10^4 d$, then
 (a) $\Delta y = \lambda$ (b) $\Delta y = 10^4 \lambda$
 (c) $\Delta y = 10^{-4} \lambda$ (d) $\Delta y = \frac{\lambda}{10}$



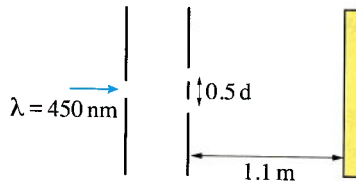
- 12 * The following diagrams show different Young's double-slit experiments, in which of these diagrams the interference fringes are separated with larger distances?



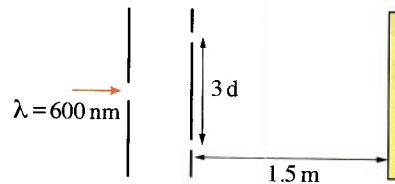
a



b



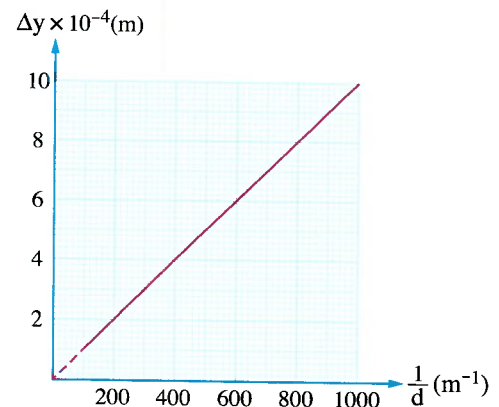
c



d

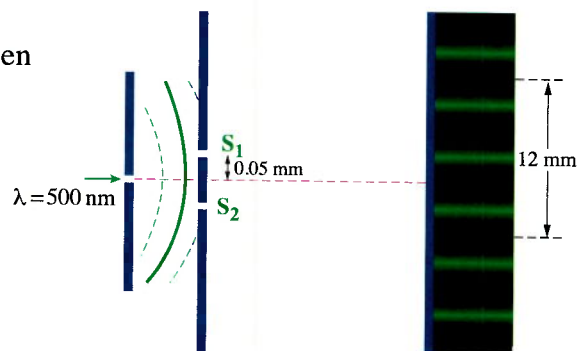
- 13 The opposite graph represents the variation of the distance between two bright successive fringes (Δy) versus the reciprocal of the distance between the double slits ($\frac{1}{d}$), if the distance between the double-slit barrier and the observation screen is 2 m, the wavelength of the used light equals

- a 5×10^{-3} m b 2×10^{-6} m
c 10^{-6} m d 5×10^{-7} m



- 14 * The opposite figure illustrates a Young's double-slit experiment, so the distance between the double-slit barrier and the observation screen in the experiment equals

- a 0.4 m
b 0.8 m
c 1.2 m
d 1.6 m



- 15 The ratio between the width of the central bright fringe in Young's double-slit experiment when using red light and its width when using violet light with holding the other factors constant is

- a greater than one b less than one
c equal to one d indeterminable

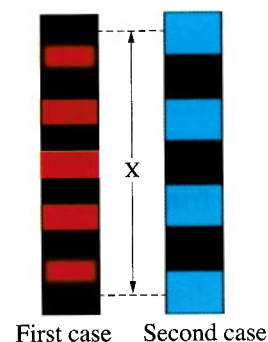
- 16 In Young's double-slit experiment, when using green light of wavelength 550 nm the separation between the centers of two successive interference fringes of the same type is 0.275 mm. When violet light of wavelength 400 nm is used, different fringes were obtained, then the distance between the centers of two successive interference fringes of the same type in the case of violet light equals

(a) 5 mm (b) 0.3 mm (c) 0.25 mm (d) 0.2 mm

- 17 In Young's double-slit experiment, if the distance between the centers of the fifth bright fringe and the central fringe is x , the distance between the centers of the second dark fringe and the central fringe is

(a) $\frac{3}{10}x$ (b) $\frac{2}{5}x$ (c) $\frac{3}{2}x$ (d) $\frac{2}{7}x$

- 18 * Young's double-slit experiment has been conducted twice, once using a red light and another using a blue light while holding the distance between the double slits unaltered, hence the opposite figure represents the interference patterns obtained in both times. If the distances between the double-slit barrier and the screen in both cases are R_r and R_b respectively, the ratio $\left(\frac{R_r}{R_b}\right)$ is



(a) greater than one (b) less than one
(c) equal to one (d) indeterminable

- 19 * In Young's double-slit experiment, an orange light of wavelength $6000 \text{ \AA}$ fell on a double slit separated by a distance $2 \times 10^{-4} \text{ m}$, so an interference pattern appeared on a screen 1 m away from the double-slit barrier. If the orange light is replaced by a violet light of wavelength $4000 \text{ \AA}$ with holding the other dimensions of the apparatus unaltered, what is the order of the bright fringe of the violet light whose center will appear at the same position as the second bright fringe of the orange light?

(a) 1 (b) 2 (c) 3 (d) 4

- 20 In Young's double-slit experiment, to obtain an interference pattern with larger distances between the interference fringes, it is preferable to use a monochromatic source of while holding the other factors constant.

(a) green light (b) red light (c) yellow light (d) violet light

- 21 * Suppose that a Young's double-slit experiment is conducted in water instead of air using the same apparatus with the same geometrical arrangement, so the interference fringes

(a) become fewer (b) become wider (c) become thinner (d) won't appear

► Light diffraction

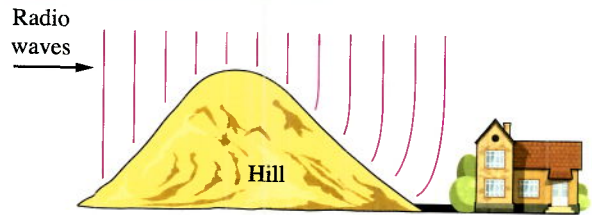
22 When a light wave passes through a slit that is narrow relative to the wavelength of light, the property that changes for the wave is

- (a) the speed (b) the wavelength
(c) the frequency (d) the direction of propagation

23 Which of the following light waves gives a more noticeable diffraction when passing through a narrow slit?

- (a) Blue light (b) Red light (c) Green light (d) Yellow light

24 The opposite figure represents a house below the level of a hill top receiving radio waves, so the reason which lets these waves reach the house is the phenomenon of

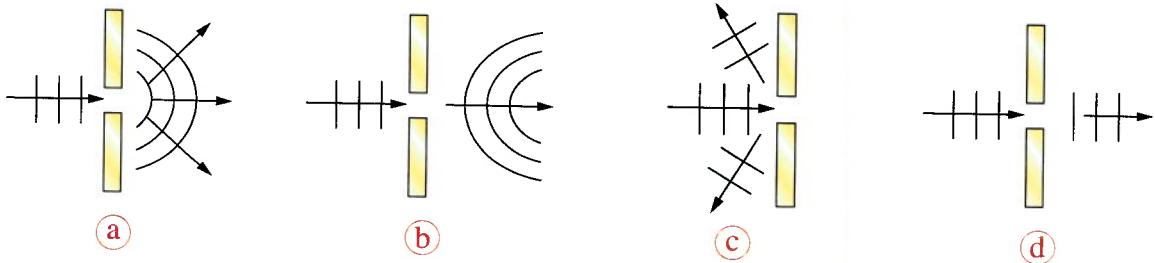


- (a) diffraction (b) interference (c) refraction (d) reflection

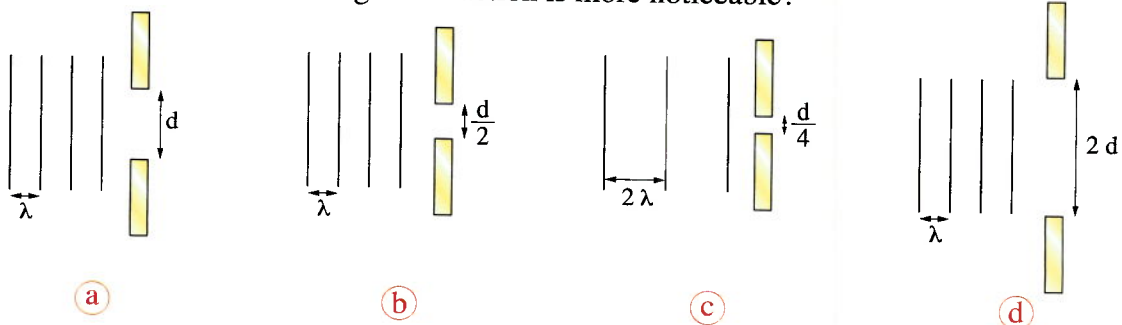
25 We **do not** observe light diffraction in our daily life because of

- (a) the high speed of visible light (b) the small frequencies of visible light
(c) the short wavelengths of visible light (d) the high intensity of visible light

26 Which of the following diagrams represents correctly the phenomenon of light diffraction when light falls on a narrow slit of size comparable to the wavelength of the incident light?

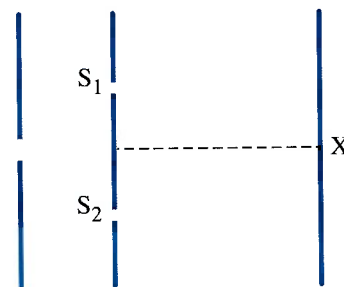


27 The following figures represent four cases in which a light wave encounters a narrow slit, so in which of these cases light diffraction is more noticeable?



- 28 In both phenomena of refraction and diffraction, there is **no** change in
 (a) the propagation (b) the speed (c) the wavelength (d) the frequency

- 29 The opposite diagram represents a Young's double-slit experiment, what are the light phenomena that occur at both positions of X and S_1 respectively?



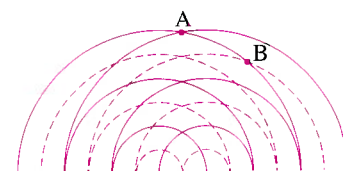
- (a) Diffraction, Diffraction
 (b) Interference, Diffraction
 (c) Diffraction, Interference
 (d) Interference, Interference

- 30 A light ray falls on a barrier with a very narrow rectangular slit, so the light is diffracted and the produced waves were received on a screen forming bright and dark fringes. What happens to each of the width and the brightness of the bright fringes as getting away from the central fringe on both sides?

	The width	The brightness
(a)	Doesn't change	Doesn't change
(b)	Doesn't change	Decreases
(c)	Decreases	Doesn't change
(d)	Decreases	Decreases

Second Essay Questions

- 1 What are the types of interference at points A and B?



- 2  Young's double-slit experiment is conducted by using red light, **what happens to** the distance between the formed interference fringes, if:
 (a) the distance between the slits is decreased?
 (b) blue light is used instead of red?
 (c) the observation screen is displaced away from the slits?
- 3 In Young's double-slit experiment:
 (a) **What** did Thomas Young prove by his experiment?
 (b) **How** did Thomas Young get two coherent light sources from one source?

4 Explain the following statements:

- (1) Light diffraction may not occur when light passes through a circular aperture.
- (2) There is no essential difference between the phenomena of interference and diffraction of light.

5 Write (changes), (constant), (formed) or (not formed) in front of each of the following properties of light:

	Frequency	Wavelength	Speed	Dark fringes	Propagation medium
Reflection					
Refraction					
Interference					
Diffraction					

Questions that measure **high levels of thinking**



Answered in detail

Choose the correct answer:

In Young's double-slit experiment, if the wavelength of the used light is changed from 400 nm to 600 nm with holding the other factors constant, the distance between the central fringe and the first dark fringe has increased by 0.01 mm, then the distance between the central fringe and the second bright fringe in the first case equals

- ☐ a 0.01 mm
 ☐ b 0.02 mm
 ☐ c 0.04 mm
 ☐ d 0.08 mm

Questions ?

Chapter

3

Lesson 3

Answered

Total Internal Reflection of Light

First

Multiple Choice Questions

Questions signed by * are answered in detail.

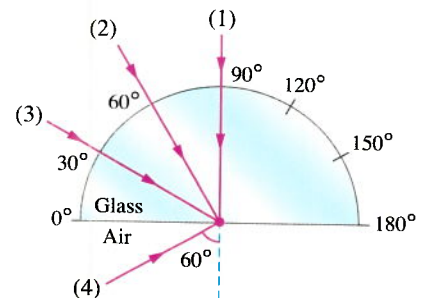
Interactive test



- 1 The total internal reflection for an incident light ray from an optically denser medium to an optically rarer medium occurs when the angle of incidence is

- (a) equal to 90° (b) greater than the critical angle
(c) equal to the critical angle (d) less than the critical angle

- 2 The opposite figure represents four incident light rays on a semi-cylindrical glass prism whose refractive index is 1.5, which of these rays undergoes total internal reflection?



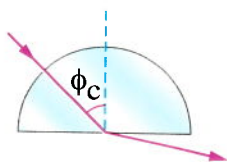
- (a) Ray (1) (b) Ray (2)
(c) Ray (3) (d) Ray (4)

- 3 The opposite table shows the absolute refractive indices of three materials x, y and z, hence total internal reflection could happen when light travels from

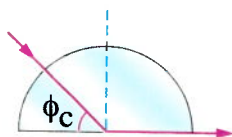
Material	Refractive index
x	1
y	1.33
z	1.5

- (a) material x to material y
(b) material x to material z
(c) material y to material z
(d) material z to material y

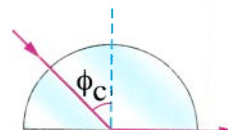
- 4 Which of the following figures represents the correct path for an incident light ray on a semi-cylindrical glass prism in which angle ϕ_c equals the critical angle?



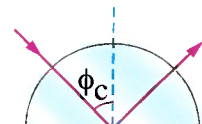
(a)



(b)



(c)

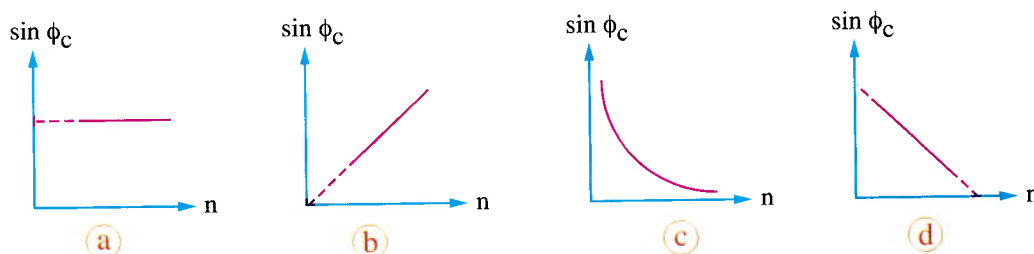


(d)

- 5 The largest angle of refraction for a light beam passing from water of refractive index $\frac{4}{3}$ to air is
 (a) 41.82° (b) 48.59° (c) 90° (d) 180°

- 6 The critical angle between two media depends on
 (a) the absolute refractive index of the optically denser medium only
 (b) the absolute refractive index of the optically rarer medium only
 (c) the absolute refractive indices of the two media
 (d) the angle of incidence of the light ray on the boundary surface between the two media

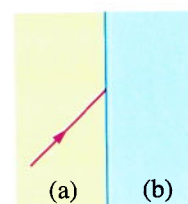
- 7 Which of the following figures represents the graph of sine of the critical angle ($\sin \phi_c$) for multiple transparent materials surrounded by air versus the absolute refractive index (n) for each of the materials?



- 8 A light ray falls from air on a liquid surface. If the angle of incidence is 30° and the angle of refraction is 22° , the critical angle for the ray when it passes from the liquid to air is
 (a) 22° (b) 30° (c) 41.4° (d) 48.5°

- 9 If the critical angle of a medium with air is 42° , the refractive index of this medium equals
 (a) $\sqrt{2}$ (b) 1.7 (c) 1.64 (d) 2

- 10 In the opposite figure, a light ray falls from medium (a) at angle 45° on the separating surface with medium (b), where it deviates from its original path by an angle of 45° , so the relative refractive index between the two media (${}_b n_a$) equals
 (a) $\sqrt{2}$ (b) $\frac{1}{\sqrt{2}}$ (c) $\frac{\sqrt{3}}{2}$ (d) $\frac{2}{\sqrt{3}}$



- 11 If the critical angle for a light ray which passes from a glass slab of refractive index 1.52 to another medium of refractive index n is 45° , the value of n equals
 (a) 1 (b) 1.07 (c) 1.33 (d) 1.52

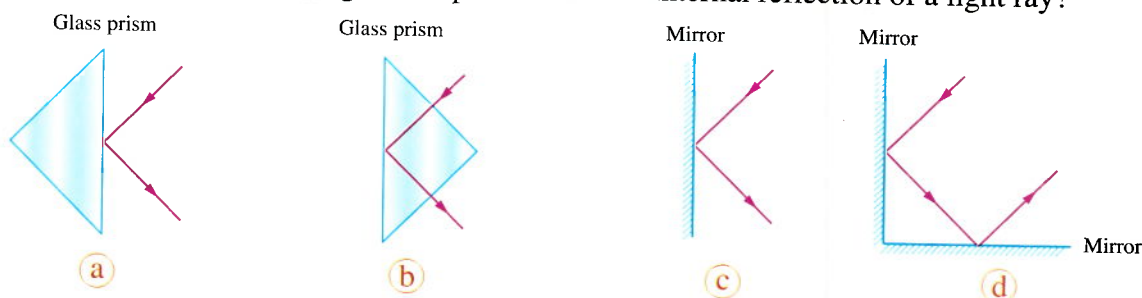
- 12 A container of glass of refractive index 1.65 contains a liquid of refractive index 1.32, so the critical angle between them is

(a) 37.31° inside the glass (b) 37.31° inside the liquid
(c) 53.13° inside the glass (d) 53.13° inside the liquid

- 13 * Three transparent materials x, y and z have critical angles with air $(\phi_c)_x$, $(\phi_c)_y$ and $(\phi_c)_z$ respectively, given that a total internal reflection could happen when light travels from material x to material y and also when it travels from material y to material z, which of the following mathematical expressions relates the critical angles of each of these materials surrounded by air?

(a) $(\phi_c)_x > (\phi_c)_y > (\phi_c)_z$ (b) $(\phi_c)_y < (\phi_c)_x < (\phi_c)_z$
(c) $(\phi_c)_x = (\phi_c)_y = (\phi_c)_z$ (d) $(\phi_c)_x < (\phi_c)_y < (\phi_c)_z$

- 14 Which of the following diagrams represents a total internal reflection of a light ray?



- 15 If the speed of light in air is 3×10^8 m/s and in another medium is 1.33×10^8 m/s, the critical angle of that medium with air equals

(a) 26.32° (b) 32.26° (c) 63.68° (d) 68.63°

- 16 If the critical angle for a light ray travelling from medium a to medium b is ϕ_c and the speed of light in medium a is v , the speed of light in medium b is

(a) $v \sin \phi_c$ (b) $v \cos \phi_c$ (c) $\frac{v}{\cos \phi_c}$ (d) $\frac{v}{\sin \phi_c}$

- 17 If the critical angle from glass to air is 42° and the critical angle from water to air is 48° , then:

(i) The relative refractive index from glass to water equals

(a) 0.8 (b) 0.9 (c) 1.11 (d) 1.8

(ii) The critical angle from glass to water equals

(a) 25.84° (b) 45° (c) 64.16° (d) 90°

- 18 The wavelengths of a light ray in two media x and y are $5500 \text{ \AA}$ and $4000 \text{ \AA}$ respectively, then the critical angle between the two media equals

(a) 11.43° (b) 43.11° (c) 46.66° (d) 89.46°

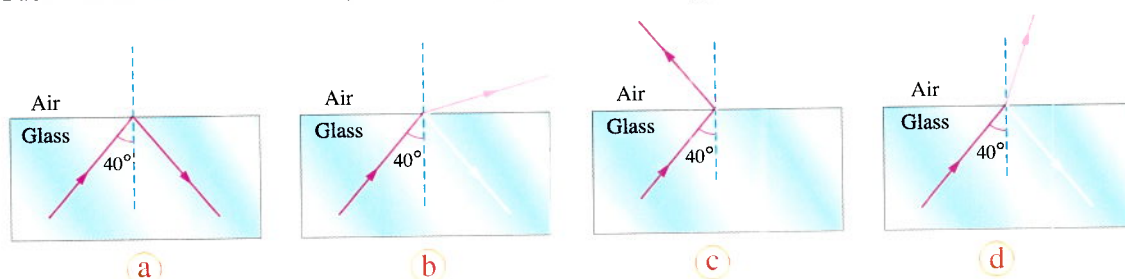
- 19 * A light ray is incident at an angle of 54° from air on the surface of a transparent medium, so a part of the ray is reflected and the other part is refracted. If the reflected and the refracted rays are perpendicular to each other, the critical angle of the transparent medium with air is

(a) 28.4° (b) 35.4° (c) 42.4° (d) 46.4°

- 20 A physician used an endoscope to examine a digestive tract tumor for a patient, the working principle of this endoscope is based on the phenomenon of

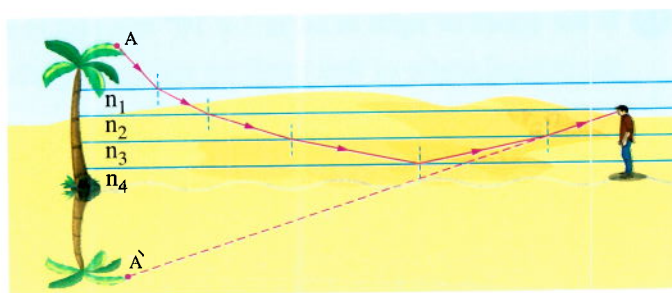
(a) light refraction (b) light interference
(c) total internal reflection of light (d) light diffraction

- 21 A light ray is incident with an angle of incidence 40° on the boundary surface between glass of refractive index 1.5 and air, so which of the following figures represents the path of the ray?



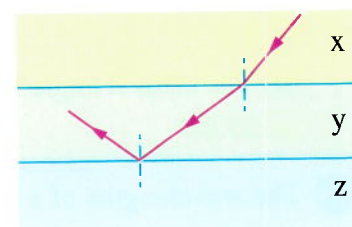
- 22 The opposite figure shows the occurrence of mirage, hence the correct order of refractive indices of air layers is

(a) $n_3 < n_2 < n_1$
(b) $n_1 < n_2 < n_3$
(c) $n_2 < n_1 < n_3$
(d) $n_3 < n_1 < n_2$



- 23 * The opposite figure represents a light ray passing from medium x to medium y towards medium z, so the relation among the absolute refractive indices for these media n_x , n_y and n_z is

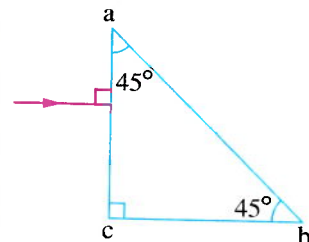
(a) $n_x < n_y < n_z$ (b) $n_z < n_y < n_x$
(c) $n_z < n_x < n_y$ (d) $n_y < n_x < n_z$



- 24 A light bulb is submerged in a liquid of refractive index $\sqrt{2}$ at a depth of 20 cm, then:
- (i) The radius of the smallest floating disk on the surface of the liquid which is enough to block the light of the light bulb is
- (a) 0.05 cm (b) 0.7 cm (c) 20 cm (d) 40 cm
- (ii) If the depth of the light bulb is increased under the liquid surface, then the radius of the disk needed to block the light of the light bulb should
- (a) increase (b) decrease (c) remain constant (d) no correct answer
- 25 A blue light source is immersed under the surface of water at a certain depth to form blue light circular spot on the surface of water. If the blue light source is replaced by a red light source, the light spot at the water surface
- (a) vanishes (b) decreases in area (c) keeps its area (d) increases in area
- 26 If $n_{\text{glass}} > n_{\text{gasoline}} > n_{\text{water}}$, the critical angle from glass to gasoline is $(\phi_c)_1$ and the critical angle from glass to water is $(\phi_c)_2$, so the ratio $\frac{(\phi_c)_1}{(\phi_c)_2}$ is
- (a) less than 1 (b) greater than 1 (c) equal to 1 (d) indeterminable

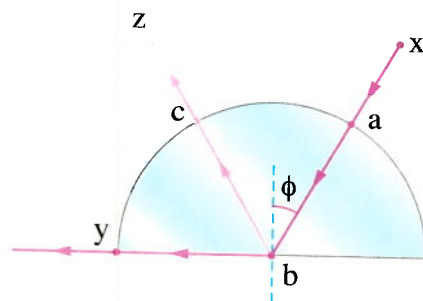
27 In the opposite figure:

- (i) If the refractive index of the prism is 1.5, the incident ray on face ab
- (a) emerges with an angle 45°
 (b) emerges with an angle 60°
 (c) emerges with an angle 90°
 (d) undergoes total internal reflection
- (ii) If the refractive index of the prism is $\sqrt{2}$, the incident ray on face ab
- (a) undergoes total internal reflection (b) emerges with an angle 60°
 (c) emerges with an angle 82° (d) emerges tangent to that face



28 In the opposite figure, what happens for the light ray when the angle of incidence ϕ increases?

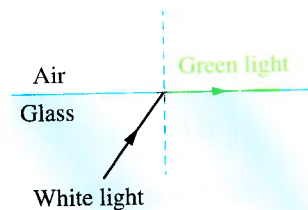
- (a) Ray xa suffers a total internal reflection at point a.
 (b) Ray bc suffers a total internal reflection at point c.
 (c) The intensity of ray bz increases.
 (d) The intensity of ray by increases.



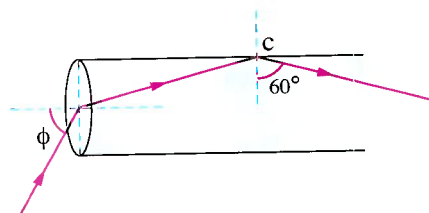
29 Which light color has the least critical angle in glass surrounded by air?

- (a) Red (b) Green (c) Yellow (d) Violet

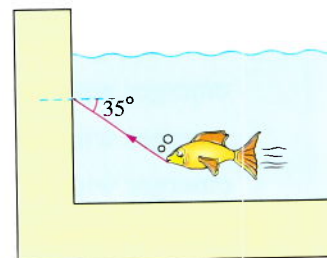
- 30 * A beam of white light is incident on the boundary surface between glass and air hence the green light gets refracted tangent to the boundary surface as shown in the opposite figure, so the light rays that emerges into air are the rays of colors



- (a) yellow, orange and red
(b) violet, indigo and blue
(c) red and blue
(d) yellow and violet
- 31 A light ray is incident from air with an angle of incidence ϕ into an optical fiber of material refractive index 1.7, so it gets refracted, then totally reflected at point c with a reflection angle 60° , as in the opposite figure, therefore the angle of incidence ϕ of the ray into the fiber equals



- (a) 38.2°
(b) 58.2°
(c) 62.8°
(d) 71.8°
- 32 A plastic transparent plate of refractive index 1.5 is used to make an aquarium. If a light ray gets reflected from a fish inside the water and falls on the plastic plate at an angle of incidence 35° as in the opposite figure, therefore the emergence angle of the light ray to the air equals



(Knowing that: $n_{\text{water}} = 1.33$)

- (a) 30.57°
(b) 35.41°
(c) 49.72°
(d) 52.33°

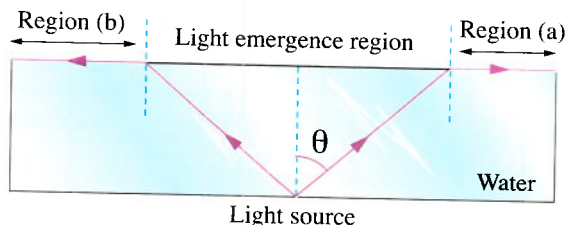
Second Essay Questions

1 Explain the following statements:

- (1) Despite the falling of a light ray from an optically denser medium to an optically rarer medium, it might not undergo total internal reflection.
- (2) Part of the light emitted from a source beneath the surface of water might not be seen in air.
- (3) Optical fibers are used in medical endoscopes.
- (4) Reflecting prisms are preferred to mirrors as reflectors in some optical instruments.
- (5)  The appearing of mirage phenomenon in the hot days in desert regions.

- 2 Four light rays are emitted from a light source under the surface of a liquid of refractive index $\sqrt{2}$. If the first ray falls perpendicularly on the surface of the liquid, the second falls at an angle of incidence 30° , the third at 45° and the fourth at 60° , **describe what happens for each ray.**

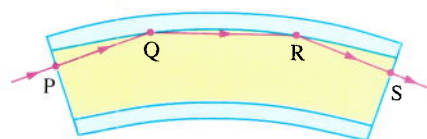
- 3 The opposite figure shows a light source at the bottom of a water container:
(Where: The refractive index of water = 1.33)



- (a) **Why** doesn't light emerge from regions (a) and (b)?

- (b) **Calculate** angle θ .

- 4 A light ray travels through an optical fiber as shown in the opposite figure,



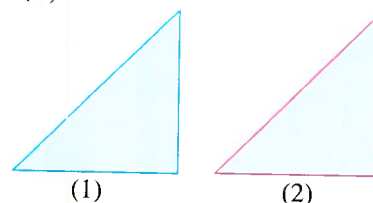
explain why:

- (a) The direction of the beam does not change at each of points S and P.
(b) There is total reflection at each of points Q and R.

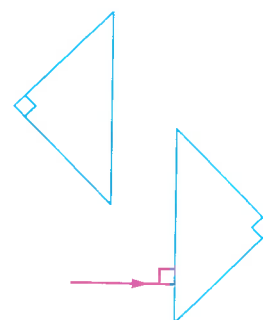
- 5 The opposite figure shows two reflecting prisms where prism (2) is coated with a transparent thin film of another material:

- (a) **What** could be the type of the material of the thin film which covers prism (2)?

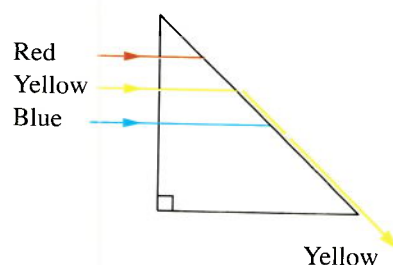
- (b) **Which** of the two prisms is more efficient? **And why?**



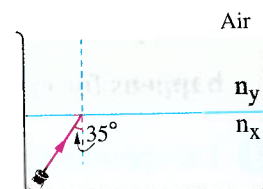
- 6 The opposite figure represents two reflecting prisms. If a light ray falls perpendicular on a face of one of them, **trace** the path of the light ray till it emerges from the other prism.



- 7 Three different colors of light rays fall perpendicularly on one of the adjacent faces to the right angle of an isosceles triangular prism. So, if the yellow ray emerges tangent to the opposite face to the right angle as shown in the opposite figure, **trace** the path of the other red and blue rays, **with explanation.**



- 8 A light bulb is placed at the bottom of a container under two layers of different liquids (x), (y). The refractive index of the lower layer is 2 while the refractive index of the upper one is 1.5. A light ray falls from the light bulb on the boundary between the two liquids at an angle of incidence 35° as shown in the opposite figure. **Trace the light ray and show if the ray will emerge to the air or not.**



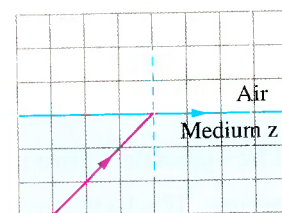
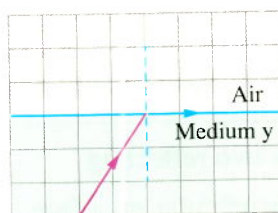
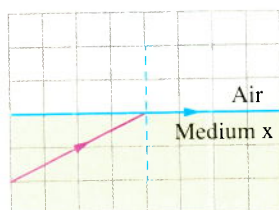
- 9 Three light sources were placed away from each other at the horizontal bottom of a swimming pool in one of the hotels where the first source gives yellow light, the second gives red light and the third gives blue light. When the three sources are switched on, three circular light spots of different colors their areas A_y, A_r, A_b respectively have appeared on the surface of water. **Arrange** ascendingly the areas of the spot circles on the water surface and **explain why** spot circles are different in areas.

Questions that measure high levels of thinking

Answered in detail

Choose the correct answer:

- 1 Three transparent materials have absolute refractive indices n_x, n_y and n_z , a light ray is incident on the interface of each of them with air as represented in the following figures,



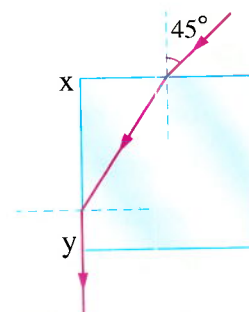
so, the speed of light

- (a) is higher in medium x
(b) is higher in medium y
(c) is higher in medium z
(d) is the same in all of them

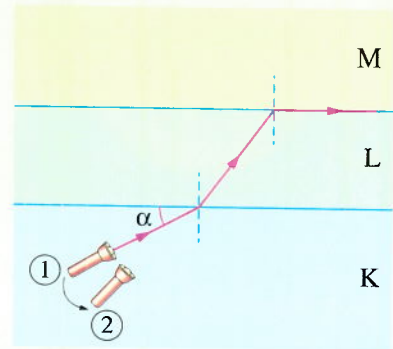
- 2 A light ray is incident on a square transparent slab as in the opposite figure, then the refractive index of the slab material that makes the ray emerges tangent to the vertical face (xy) of the slab equals

(Where: $\sin(90^\circ - \theta) = \cos \theta$)

- (a) 0.816
(b) 1.15
(c) 1.225
(d) 1.375

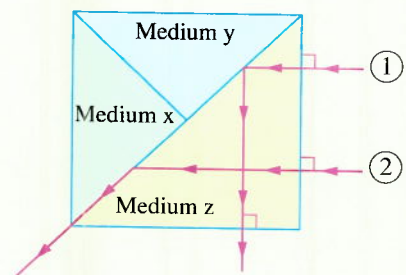


- 3 Three layers of transparent materials (M, L, K) through which a light ray passes from material K towards material M as shown in the opposite figure, if the light source is moved from position ① to position ② such that the angle α gets increased, the light ray when it falls on the boundary surface between material L and material M will



- (a) be refracted towards the normal
- (b) be refracted away from the normal
- (c) be refracted tangent to the boundary surface
- (d) undergoes total internal reflection

- 4 The opposite figure shows the paths of two light rays, so what is the correct order for the absolute refractive indices of the three media x, y and z?



- (a) $n_z < n_y < n_x$
- (b) $n_y < n_x < n_z$
- (c) $n_z < n_x < n_y$
- (d) $n_x < n_y < n_z$

- 5 A light ray falls from glass on the boundary surface with air at an angle of incidence that equals the critical angle, so it gets refracted tangent to the glass surface. If a layer of water is placed on the glass surface, then the angle of emergence of the ray to air equals

(Given that: the refractive index of glass = 1.5, the refractive index of water = $\frac{4}{3}$)

- (a) 42°
- (b) 48°
- (c) 62°
- (d) 90°

Questions ?

Chapter

3

Lesson 4

Answered

Deviation of Light in a Triangular Prism

First

Multiple Choice Questions

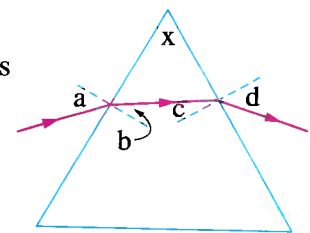
Questions signed by * are answered in detail.

Interactive test



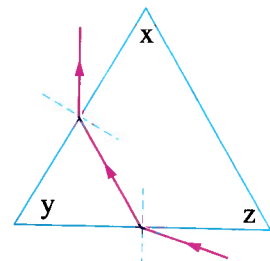
- 1 The opposite figure represents the path of a light ray through a triangular prism, what is the mathematical expression that relates correctly angle x with the other shown angles in the figure?

- (a) $x = a + d$ (b) $x = a - b$
(c) $x = b - c$ (d) $x = b + c$

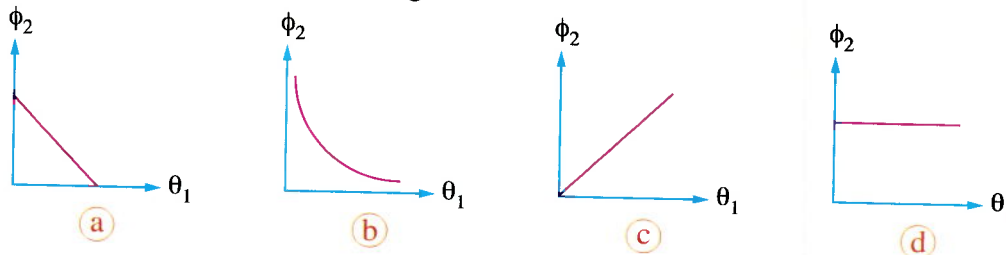


- 2 Which of the angles shown in the opposite figure represents the apex angle of the prism?

- (a) Angle x (b) Angle y
(c) Angle z (d) The three angles



- 3 Which of the following graphs represents the relation of the second angle of incidence (ϕ_2) versus the angle of refraction (θ_1) for a light ray that gets incident on the face of a triangular prism with different angles of incidence?



- 4 The following three physical quantities are related to the deviation of light in a triangular prism:

- (I) The apex angle of the prism
(II) The refractive index of the prism's material for the used light
(III) The first angle of incidence

So, on which of these quantities does the second angle of incidence in the triangular prism depend?

- (a) (I), (II) (b) (I), (III) (c) (II), (III) (d) (I), (II), (III)

- 5 A ray of light falls on a triangular glass prism at an angle of incidence 45° and emerges with an angle of 52° . If the refractive index of the prism material is 1.5, its apex angle equals

a 28.13° b 30.18° c 31.69° d 59.82°

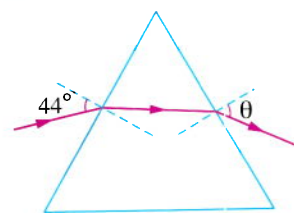
- 6 The opposite figure shows the path of a light ray through an equilateral triangular prism of refractive index 1.5, so :

(i) The emergence angle of the ray (θ) equals

a 47.2° b 43°
c 53.5° d 27°

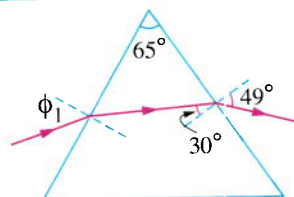
(ii) The angle of deviation of the ray equal

a 32.3° b 37.5° c 45.2° d 53.5°



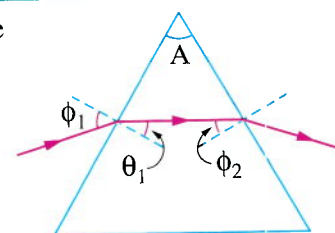
- 7 The opposite figure shows the path of a light ray that falls on one of the faces of a triangular prism, so the angle of deviation of the light ray is approximately equal to

a 30° b 35°
c 44° d 56°



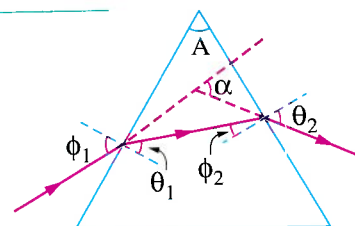
- 8 In the opposite figure, what is the effect of increasing the angle of incidence (ϕ_1) on the angle of refraction (θ_1) and the second angle of incidence (ϕ_2)?

a Both angles increase.
b Both angles decrease.
c θ_1 increases and ϕ_2 decreases.
d θ_1 decreases and ϕ_2 increases.



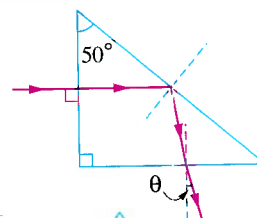
- 9 * In the opposite figure, if $\phi_1 > \theta_2$ and $\alpha = A$, the angle of incidence (ϕ_1) might be equal to

a $\frac{1}{2} A$ b A
c $\frac{4}{3} A$ d $2 A$



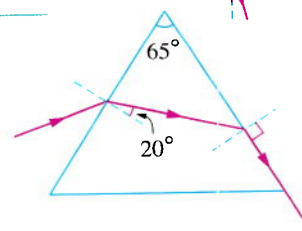
- 10 In the opposite figure, if the refractive index of the prism's material is 1.5, angle θ is approximately equal to

a 20° b 18°
c 15° d 10°



- 11 The opposite figure represents the path of a light ray through a triangular prism, hence the deviation angle of the light ray equals

a 65° b 53.9°
c 45° d 28.9°

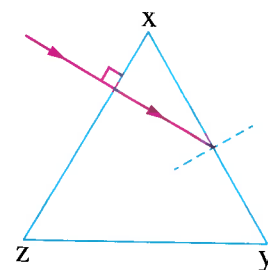


- 12 If a light ray is incident normal to one of the right angle faces of an isosceles triangular prism of refractive index $\sqrt{2}$, the light ray that falls on the face opposite to the right angle

(a) emerges tangent to this face
 (b) emerges by an angle of emergence of 60°
 (c) undergoes total internal reflection
 (d) emerge by an angle 70°

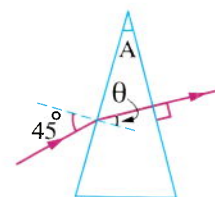
- 13 * In the opposite figure, a light ray is incident normally on face xz of an equilateral triangular prism whose refractive index is $\sqrt{2}$, hence the ray

(a) emerges from face xy
 (b) emerges from face xz
 (c) deviates from its path by an angle of 120°
 (d) deviates from its path by an angle of 60°



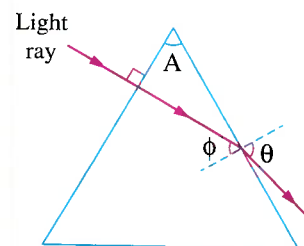
- 14 In the opposite figure, the apex angle (A) of the prism is

(a) greater than 45° (b) less than 45°
 (c) equal to 45° (d) indeterminable



- 15 In the opposite figure, the apex angle (A) of the prism is

(a) greater than angle θ (b) less than angle θ
 (c) greater than angle ϕ (d) less than angle ϕ



- 16 A light ray falls normally on one of the faces of a triangular prism of apex angle 30° , if the refractive index of the prism is $\sqrt{2}$, then:

(i) The angle of emergence of the ray from the prism equals

(a) 15° (b) 30° (c) 45° (d) 60°

(ii) The angle of deviation of the ray equals

(a) 15° (b) 30° (c) 45° (d) 60°

- 17 If a ray of light falls perpendicularly on one of the faces of a triangular prism of apex angle 45° and emerges tangent to the other face, then the refractive index of the prism's material is

(a) 1.2 (b) $\sqrt{3}$ (c) $\sqrt{2}$ (d) $2\sqrt{2}$

- 18 A light ray falls perpendicularly on one of the faces of a triangular prism of apex angle 30° , so it gets deviated by an angle that equals 20° , therefore the refractive index of the prism material is

(a) 1.25 (b) 1.44 (c) 1.53 (d) 1.66

- 19 A light ray falls at an angle of incidence 60° on one of the faces of a triangular prism whose apex angle is 40° , to emerge perpendicular from the other face, then the refractive index of the prism is

(a) 1.35 (b) 1.29 (c) 1.21 (d) 1.13

- 20 A ray of light falls from air on the face of a triangular glass prism whose apex angle is 72° to get refracted by an angle of 30° then emerge tangent to the other face, so the critical angle between glass and air is

(a) 30° (b) 42° (c) 48° (d) 60°

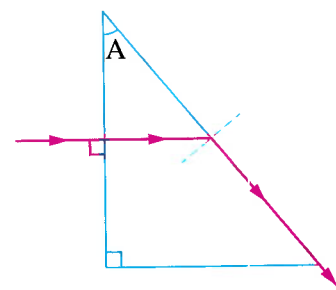
- 21 * In the opposite figure, if the refractive index of the prism is 1.5, the emergence angle of the light ray from the prism equals

(a) 19.47° (b) 41.81°
(c) 48.59° (d) 60°



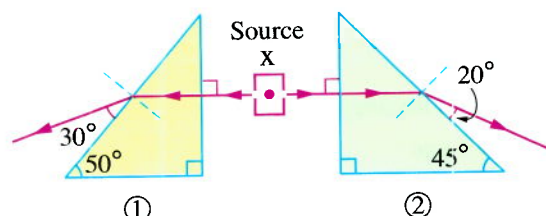
- 22 * In the opposite figure, a light ray passes through a triangular prism of a transparent material with a speed that equals $0.8c$ where c is the speed of light in air, so angle A is approximately equal to

(a) 37° (b) 40°
(c) 50° (d) 53°



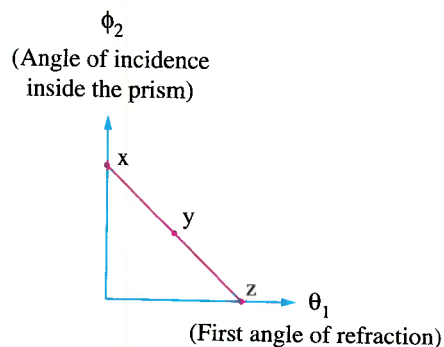
- 23 * Two light rays are emitted from source x to pass through two prisms ① and ② of different materials of refractive indices n_1 and n_2 respectively as shown in the opposite figure, hence the correct relation between these refractive indices is

(a) $n_1 < n_2$ (b) $n_2 < n_1$ (c) $n_1 = n_2 \neq 1$ (d) $n_1 = n_2 = 1$

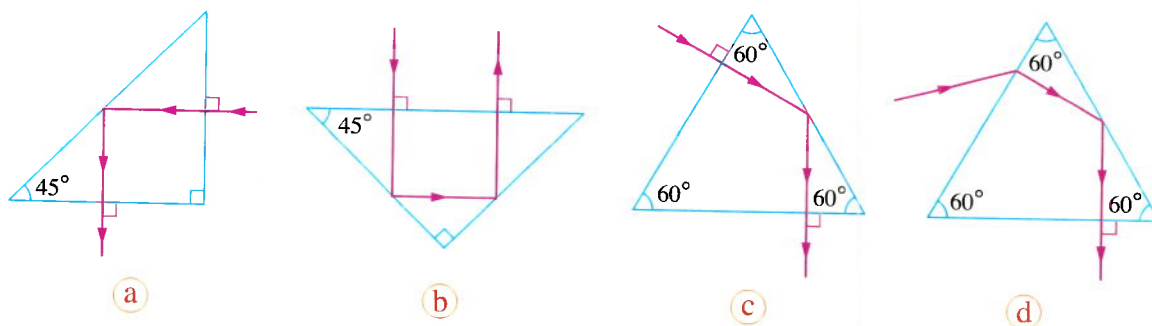


- 24 In the opposite graph, which of the shown points represents the state of a light ray that is incident normal on one of the faces of a triangular prism?

- a Point x
- b Point y
- c Point z
- d None of them.

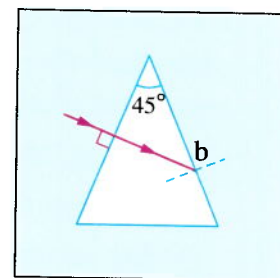


- 25 In which of the following cases the path of the light ray is **not** represented correctly, given that the refractive index of the material of the triangular prisms in all cases equals 1.5?



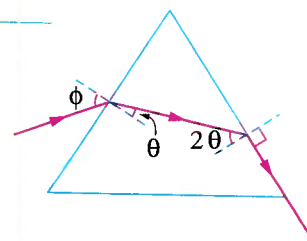
- 26 The opposite figure shows a light ray which falls perpendicularly on one of the faces of a triangular glass prism that is immersed in a liquid of refractive index 1.33. If the critical angle of the glass with air is 42° , the light ray at point b

- a gets totally reflected
- b gets refracted away from the normal line
- c gets refracted tangent to the face of the prism
- d gets refracted toward the normal line



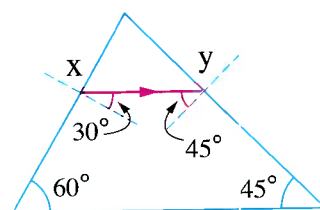
- 27 * The opposite figure shows a light ray falling on one of the faces of an equilateral triangular prism. The angle of incidence (ϕ) equals

- a 45.52°
- b 36.24°
- c 32.25°
- d 27.22°



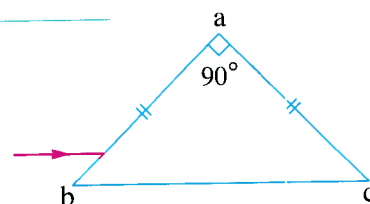
- 28 In the opposite figure, if the critical angle of the prism's material is 42° , the first angle of incidence and the angle of emergence respectively are

(a) $60^\circ, 90^\circ$ (b) $60^\circ, 0^\circ$
(c) $48.16^\circ, 0^\circ$ (d) $48.16^\circ, 90^\circ$



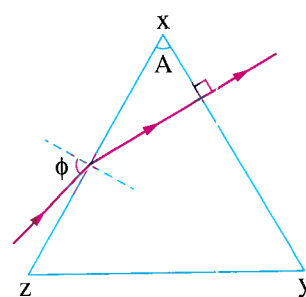
- 29 The opposite figure shows a light ray falling parallel to the base on the face of a right angled triangular glass prism whose refractive index is 1.5, then the angle of emergence equals

(a) 28.13° (b) 45° (c) 60° (d) 73.13°



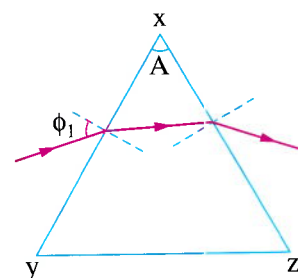
- 30 In the opposite figure, a light ray is incident on a glass triangular prism of refractive index 1.5 that is surrounded by air, so when reducing the angle of incidence (ϕ) by 5° , the light ray

(a) emerges from face xy refracted away from the normal
(b) emerges from face xy refracted towards the normal
(c) emerges from face xy tangent to the interface
(d) undergoes total internal reflection at face xy



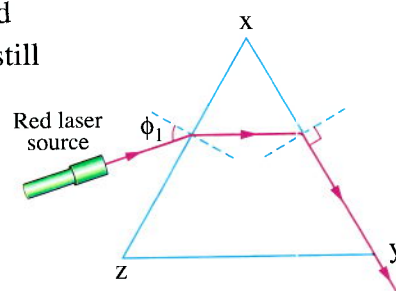
- 31 A light ray is incident from air with an angle of incidence ϕ_1 on one of the faces of a triangular prism of apex angle A and refractive index n as shown in the opposite figure, which of the following modifications could make the light ray undergo total internal reflection at face xz?

(a) Increasing the angle of incidence ϕ_1
(b) Decreasing the angle of incidence ϕ_1
(c) Using another prism of the same material with a smaller apex angle A
(d) Using another prism of a material with a refractive index smaller than n



- 32 In the opposite figure, if the red laser source is required to be changed with a blue laser source, yet the light ray is still wanted to emerge tangent to the face of the prism, how does the angle of incidence ϕ_1 be changed to achieve that?

(a) It should be increased.
(b) It should be decreased.
(c) It shouldn't be changed.
(d) The answer is indeterminable.

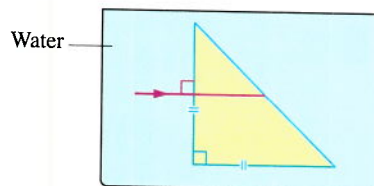


Second Essay Questions

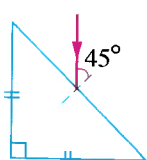
1 What are the factors on which the angle of deviation of the light ray in the triangular prism depends?

2 In the opposite figure:

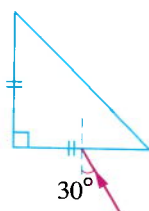
Trace the path of the incident light ray till it emerges from the prism, where the critical angle of the prism's material with air is 42° and the absolute refractive index of water is 1.33.



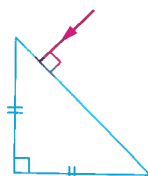
3 The following figures show four different cases of the fall of a light ray on one of the faces of a right angled isosceles triangular prism of refractive index 1.5:



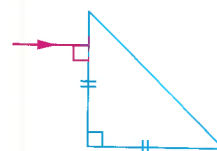
(1)



(2)



(3)



(4)

In which of these figures the following actions happen? Illustrate your answer with drawings.

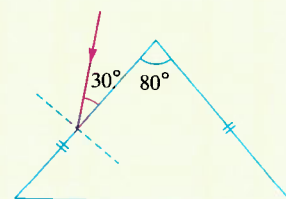
- (a) The ray deviates with an angle 90°
- (b) The ray emerges from the same face of its incidence.
- (c) The ray suffers total internal reflection twice inside the prism.
- (d) The ray emerges by an angle 30°

Questions that measure high levels of thinking

Answered in detail

Choose the correct answer:

1 The opposite figure shows a light ray falling on one of the faces of an isosceles triangular prism which is made of a material of refractive index 1.5, then the angle of deviation of the ray equals



(a) 14.74°

(b) 22.44°

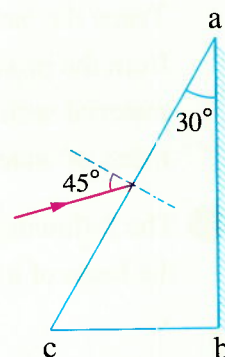
(c) 32.44°

(d) 50.2°

- 2 Which of the following angles in an equilateral triangular prism of refractive index 1.5 could have possible value of 0° or 90° ?

(a) The deviation angle (α). (b) The second angle of incidence (ϕ_2).
(c) The angle of refraction (θ_1). (d) The angle of emergence (θ_2).

- 3 A triangular glass prism abc, whose face ab is silvered, has an apex angle of 30° as in the opposite figure. When a light ray falls at an angle of 45° on face ac, the ray gets refracted inside the prism then it gets reflected on the silvered face and retraces its path, so the refractive index of the prism equals

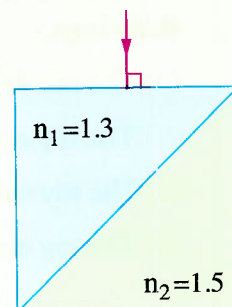


(a) $\frac{\sqrt{2}}{2}$ (b) $\sqrt{2}$
(c) $\frac{\sqrt{6}}{3}$ (d) $\frac{\sqrt{6}}{2}$

- 4 A triangular prism has an apex angle 60° and refractive index $\sqrt{3}$, so the minimum angle of incidence of a ray on one of the faces of the prism that makes the ray emerge from the other face of the prism is

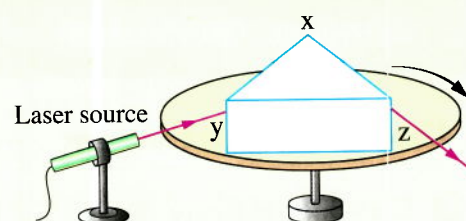
(a) 32.32° (b) 37.37° (c) 42.42° (d) 46.46°

- 5 In the opposite figure, a light ray falls from air normal to the face of a cube that is formed of two prisms of different types of glass, then its angle of emergence from this cube is



(a) 7.21° (b) 10.85°
(c) 37.79° (d) 45°

- 6 The opposite figure represents a triangular prism (xyz) placed on a rotatable disk in which a laser light ray is incident on face xy and emerges tangent to face xz, so if the disk is rotated slightly in the clockwise direction, the laser light ray at face xz will



(a) emerge with an angle smaller than 90°
(b) emerge tangent to face yz
(c) undergo total internal reflection inside the prism
(d) emerge normal to face xz

Questions ?

Chapter 3 | Lesson 5

Answered

Triangular Prism at the Minimum Deviation Position

First

Multiple Choice Questions

Questions signed by * are answered in detail.

Interactive test



- 1 When a prism is in the minimum deviation position, the refractive index of the prism is determined from the relation;

(a) $n = \frac{\sin \phi_1}{\sin \theta_2}$

(b) $n = \frac{\frac{\sin(\alpha_o + A)}{2}}{\frac{\sin A}{2}}$

(c) $n = \frac{\sin \phi_1}{\sin \phi_2}$

(d) $n = \frac{\sin A}{\sin \alpha_o}$
- 2 If the deviation angle for a light ray that passes through an equilateral triangular prism in the minimum deviation position is 30° , then:
 - (i) The angle of incidence of the ray on the prism face equals

(a) 30°

(b) 45°

(c) 60°

(d) 90°
 - (ii) The emergence angle of the ray from the prism equals

(a) 90°

(b) 60°

(c) 45°

(d) 30°
- 3 * The opposite graph shows the relation between the angle of deviation (α) and the first angle of incidence (ϕ_1) for a light ray on one of the faces of a triangular prism, so:

- (i) The apex angle of the prism equals

(a) 30°

(b) 45°

(c) 60°

(d) 90°
 - (ii) The absolute refractive index of the prism material equals

(a) 1.5

(b) $\sqrt{2}$

(c) 1.33

(d) $\sqrt{3}$
 - (iii) The emergence angle of the ray at the position x equals

(a) 30°

(b) 37°

(c) 45°

(d) 75°
- 4 A triangular prism has an apex angle of 60° and a refractive index of $\sqrt{2}$, then the angle of deviation and the angle of incidence at the minimum deviation position respectively are

(a) $30^\circ, 45^\circ$

(b) $45^\circ, 30^\circ$

(c) $60^\circ, 45^\circ$

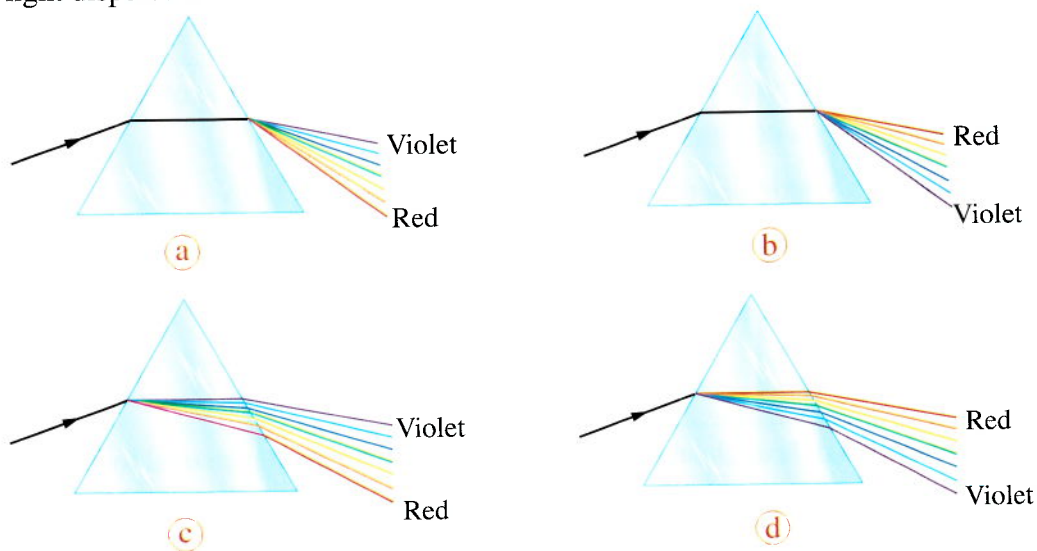
(d) $45^\circ, 60^\circ$

- 5 If a light ray is incident on an equilateral triangular prism and undergoes the minimum deviation, the second angle of incidence inside the prism equals
- (a) 30° (b) 45° (c) 60° (d) 90°
- 6 A light ray is incident on an equilateral triangular prism, if the angle of incidence = the angle of emergence = 40° , then:
- (i) The angle of deviation of the light ray equals
- (a) 20° (b) 40° (c) 60° (d) 80°
- (ii) The refractive index of the prism's material equals
- (a) 1.1 (b) 1.15 (c) 1.29 (d) 1.53
- 7 A light ray deviated through an equilateral glass prism by an angle equal to its first angle of incidence, which is 60° . So, the refractive index of the prism material equals
- (a) $\sqrt{2}$ (b) $\frac{1}{\sqrt{2}}$ (c) $\sqrt{3}$ (d) $\frac{1}{\sqrt{3}}$
- 8 * A light ray is incident with an angle ϕ_1 on one of the faces of an equilateral triangular prism, hence it gets refracted by an angle of 30° , what happens to the deviation angle of the light ray (α) when increasing or decreasing the angle of incidence (ϕ_1) by 5° ?

	Increasing ϕ_1	Decreasing ϕ_1
(a)	Increases	Decreases
(b)	Increases	Increases
(c)	Decreases	Decreases
(d)	Decreases	Increases

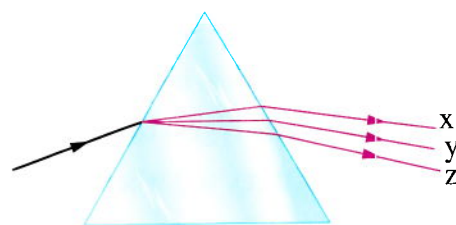
- 9 The ratio between the refractive index of the material of a triangular prism for violet light and the refractive index of the material of the same prism for red light ($\frac{n_{\text{violet}}}{n_{\text{red}}}$) is
- (a) greater than one (b) less than one (c) equal to one (d) indeterminable
- 10 The ratio between the deviation angle of violet light and the deviation angle of red light through a triangular prism at minimum deviation position is
- (a) greater than 1 (b) less than 1 (c) equal to 1 (d) indeterminable

- 11  If a narrow beam of white light falls on one of the faces of a triangular prism in the minimum deviation position, which of the following figures shows how this beam of light disperses?



- 12 The opposite figure represents the dispersion of white light by a glass prism, so the light rays x, y and z might have the colors of

	x	y	z
(a)	Blue	Yellow	Red
(b)	Red	Blue	Yellow
(c)	Red	Yellow	Blue
(d)	Yellow	Red	Blue



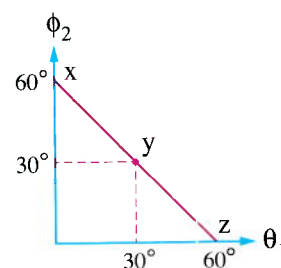
- 13 The opposite graph shows the relation between the second angle of incidence (ϕ_2) and the first angle of refraction (θ_1) of a light ray falling into a triangular prism. If the angle of minimum deviation is 30° , so:

(i) The refractive index of the prism equals

- (a) $\sqrt{2}$ (b) 1.48
(c) $\sqrt{3}$ (d) 1.55

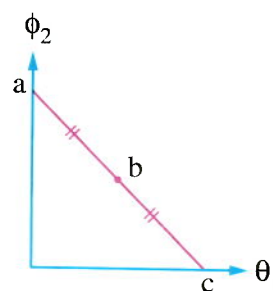
(ii) The angle of emergence of the light ray from the prism when it is in the minimum deviation position equals

- (a) 15° (b) 30° (c) 45° (d) 60°



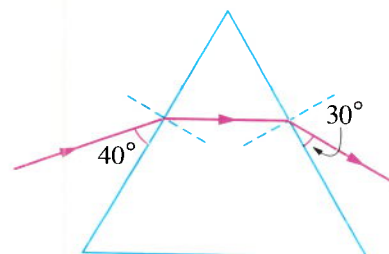
- 14  The opposite graph represents the relation between the second angle of incidence (ϕ_2) and the angle of refraction (θ_1) when a light ray passes through an equilateral triangular prism, so the position of minimum deviation is represented by point

(a) a (b) b
(c) c (d) a and c



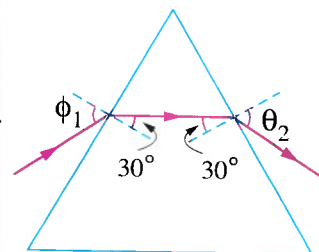
- 15 Which of the following values is the possible value of the angle of deviation for the light ray that passes through the prism shown in the opposite figure if the minimum angle of deviation through that prism is 45° ?

(a) 22.5° (b) 30°
(c) 45° (d) 50°



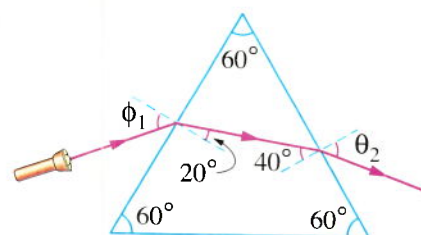
- 16 The opposite figure shows a triangular prism where a light ray falls on one of its faces at an angle ϕ_1 and emerges from the other face at an angle θ_2 , so the ratio $\left(\frac{\sin \phi_1}{\sin \theta_2}\right)$ equals

(a) $\frac{1}{2}$ (b) $\frac{1}{1}$
(c) $\frac{1}{\sqrt{2}}$ (d) $\frac{1}{\sqrt{3}}$



- 17 * In the opposite figure, to set the prism in the minimum deviation position, we have to

(a) increase the angle of incidence (ϕ_1)
(b) direct the light ray normal onto the face of the prism
(c) increase the angle of incidence (ϕ_2)
(d) direct the light ray tangent onto the face of the prism



- 18 * The opposite figure shows a light ray falling on one of the faces of a triangular prism at an angle ϕ_1 , if $\hat{a} = \hat{b}$ and $\phi_1 = 1.5 \phi_2$, then:

(i) The apex angle of the prism equals

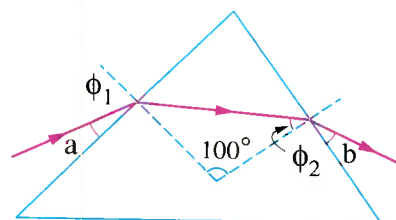
(a) 20° (b) 60°
(c) 80° (d) 100°

(ii) The first angle of incidence (ϕ_1) equals

(a) 20° (b) 40° (c) 60° (d) 80°

(iii) The refractive index of the prism equals

(a) 1.05 (b) 1.14 (c) 1.35 (d) 1.53

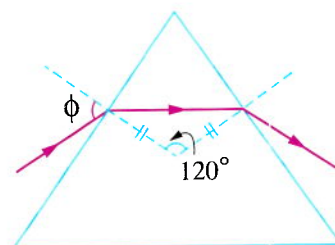


- 19 A triangular prism has an apex angle that equals $1.5 \alpha_0$, where α_0 is the minimum deviation angle for the prism while the prism becomes in minimum deviation position when a light ray falls on one of its faces with an angle of incidence 50° , hence the refractive index of the prism equals

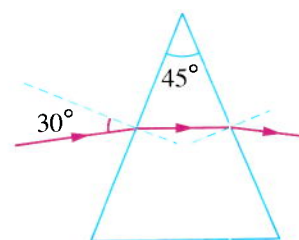
(a) 1.25 (b) 1.42 (c) 1.53 (d) 1.73

- 20 The opposite figure illustrates the deviation of a light ray through a prism of refractive index $\sqrt{3}$, so

	The first angle of incidence (ϕ)	The angle of deviation (α)
(a)	30°	30°
(b)	30°	60°
(c)	60°	30°
(d)	60°	60°



- 21 The opposite figure shows an isosceles triangular prism, having an apex angle of 45° and made of a transparent material. If a light ray falls on one of its faces at an angle of 30° and gets refracted inside the prism parallel to the base, then:



- (i) The angle of emergence of the light ray from the prism equals

(a) 15° (b) 30° (c) 45° (d) 60°

- (ii) The angle of deviation of the light ray equals

(a) 60° (b) 45° (c) 30° (d) 15°

- (iii) The refractive index of the prism equals

(a) 1.22 (b) 1.27 (c) 1.31 (d) 1.6

- 22 * The apex angle of a triangular prism is 60° and its refractive index is 1.5. If it's submerged in a liquid whose refractive index is 1.3, then:

- (i) The minimum angle of deviation will equal

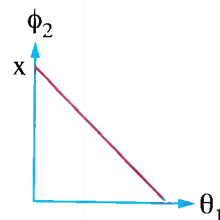
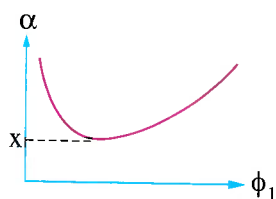
(a) 8.4° (b) 9.6° (c) 10.5° (d) 35.1°

- (ii) The first angle of incidence in the position of minimum deviation will equal

(a) 34.34° (b) 35.25° (c) 47.55° (d) 60°

Second Essay Questions

- 1 **What happens when** a beam of parallel rays of white light falls on a triangular prism adjusted in the minimum deviation position?
- 2 **Explain the following statements:**
 - (1) In the same triangular prism the angle of minimum deviation changes by the change of the wavelength of the passing light through it.
 - (2)  When white light falls on a triangular prism, the deviation of the violet light will be greater than that of the red light.
 - (3) Triangular prisms disperse white light while the transparent cuboid slabs don't.
- 3 **What** are the factors on which the minimum angle of deviation in a triangular prism depend?
- 4 **What does the value of x in each of the following graphs indicate?**
 - (a) The relation between the angle of deviation (α) of a light ray in a triangular prism and the first angle of incidence (ϕ_1) for the light ray on one of the faces of the prism.
 - (b) The relation between the second angle of incidence (ϕ_2) and the first angle of refraction (θ_1) for a ray passing through a triangular prism.



Questions

Chapter 4

Answered

Laws of Circular Motion

First

Multiple Choice Questions

Questions signed by * are answered in detail.

Interactive
test



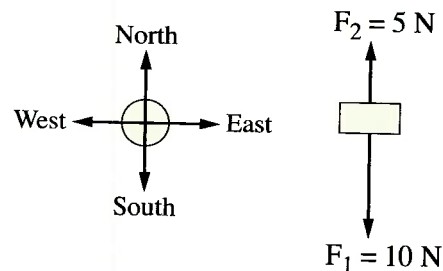
► Uniform circular motion - Types of centripetal force

- 1 A body is moving with a constant velocity in a certain direction, so if a force acts on this body in a direction that opposes its motion, what happens to each of the magnitude and the direction of the body's velocity?

	Magnitude of velocity	Direction of velocity
(a)	decreases	doesn't change
(b)	increases	doesn't change
(c)	remains constant	changes
(d)	remains constant	doesn't change

- 2 A body moves towards the east with a constant velocity. If two horizontal forces F_1 and F_2 act on that body as in the opposite figure, the body's velocity

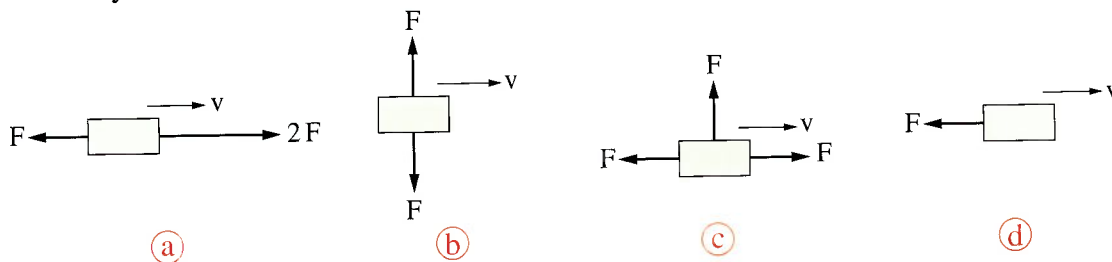
- (a) changes in magnitude only
(b) changes in direction only
(c) changes in magnitude and direction
(d) remains unchanged



- 3 When a body undergoes a uniform circular motion, the direction of the centripetal force that acts on the body is

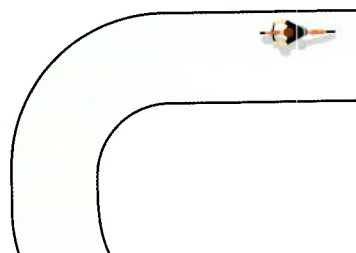
- (a) in the same direction of the body's motion
(b) perpendicular to the direction of the body's motion
(c) opposite to the direction of the body's motion
(d) tangent to the path of the body's motion

- 4 A body moves with a constant velocity v in a straight line, so if the body gets affected by constant forces in different scenarios as shown in the following figures, in which scenario the body makes a uniform circular motion?



- 5 The opposite figure shows a bicycle driver moving on a road, so to keep moving in the curved road without going into a skid, the driver has to

- (a) speed up the bicycle to let a force be generated perpendicular to the direction of the motion
 (b) speed up the bicycle to let a force be generated in the same direction of the motion
 (c) lean his bicycle towards the center of the curved road to let a force be generated perpendicular to the direction of the motion
 (d) lean his bicycle towards the center of the curved road to let a force be generated in the same direction of the motion



- 6 Which of the following represents the centripetal force acting on a car moving on a horizontal curved road?

- (a) Weight. (b) Reaction force of the road.
 (c) Friction force. (d) The previous three forces.

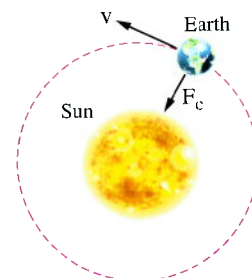
- 7 A body moves in uniform circular motion in a path of radius (r) under the influence of a centripetal force (F_c). So, the work done on this body by the force (F_c) during half a revolution equals

- (a) 0 (b) $\frac{1}{2} F_c r$ (c) $F_c r$ (d) $2 F_c r$

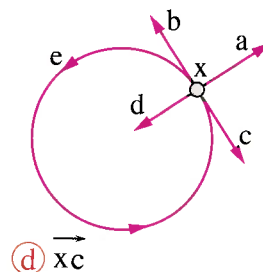
► The centripetal acceleration

- 8 The opposite figure represents the motion of Earth around Sun in a circular orbit, so the angle between the directions of the centripetal acceleration and the centripetal force (F_c) equals

- (a) 0° (b) 90°
 (c) 180° (d) 270°



- 9 A child holds a string with a stone tied at its end and moves it to rotate in a horizontal plane as shown by the direction of arrow e in the opposite figure. If the child suddenly lets go of the string while the stone is at position x, the stone, at the moment of release, will move in the direction



- (a) $\vec{xd}$ (b) $\vec{xa}$ (c) $\vec{xb}$ (d) $\vec{xc}$
- 10 A car negotiates a horizontal curved road of curvature radius 100 m at a constant speed of 20 m.s^{-1} , so the centripetal acceleration is

- (a) 0.25 m.s^{-2} (b) 5 m.s^{-2} (c) 2 m.s^{-2} (d) 4 m.s^{-2}
- 11 If the tangential velocity with which a body moves in a horizontal circular path is 7 m/s and the body completes 4 turns through two minutes, the radius of the circular path equals

- (a) 66.8 m (b) 25.2 m (c) 33.4 m (d) 30.6 m

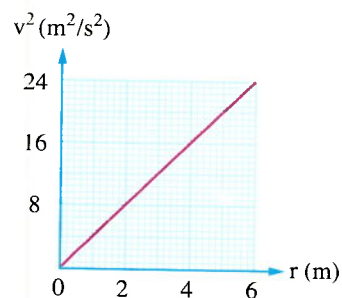
- 12 Two bodies (A and B) move in the same horizontal circle with the same speed. If the mass of body A is double that of body B, the magnitude of centripetal acceleration with which body A moves is the magnitude of centripetal acceleration with which body B moves.

- (a) equal to (b) two times as large as
(c) half (d) quarter

- 13 * If the centripetal acceleration of a body rotating in a horizontal circular path is 10 m/s^2 , and the tangential velocity of this body increases to double, and the radius of its circular path decreases to its half, so the centripetal acceleration required for the rotation of the body in the new circular path will be

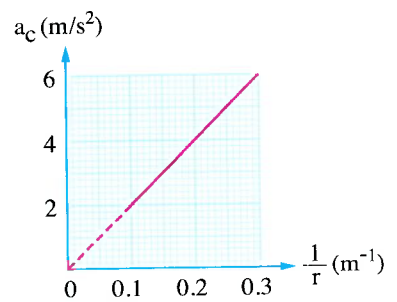
- (a) 5 m/s^2 (b) 20 m/s^2 (c) 40 m/s^2 (d) 80 m/s^2

- 14 A stone tied to a string rotates in a horizontal circular path with tension force (F) and the opposite graph shows the relationship between the square of the tangential velocity (v^2) for the stone and the radius of the path (r) at constant tension force (F), so the centripetal acceleration with which the stone moves is

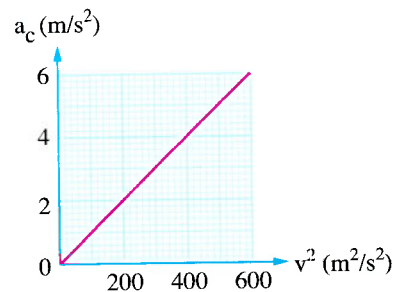


- (a) 2 m/s^2 (b) 4 m/s^2
(c) 6 m/s^2 (d) 8 m/s^2

- 15 * A body moves several times with the same speed in horizontal circular paths of different radii and the opposite graph shows the relationship between the centripetal acceleration (a_c) with which the body moves and the reciprocal of the path radius ($\frac{1}{r}$), then the tangential speed with which the body moves equals



- 16 * A body got to move in a circular path of radius (r) several times while changing its speed each time, and the opposite graph represents the relationship between the centripetal acceleration (a_c) with which the body moves and the square of its linear velocity (v^2), then the radius (r) of this circular path equals



- 17 * In one of the amusement park games, the chairs rotate in uniform horizontal circular paths. If one of the chairs is 1.5 m away from the center while another chair is 2 m away from the center and both of them are on the same straight radial line with the center, which of them is moving with a higher tangential velocity?
- (a) The chair that is 1.5 m away from the center.
 (b) The chair that is 2 m away from the center.
 (c) Both of them have the same speed.
 (d) The periodic time must be given to determine the answer.



► Centripetal force

- 18 A body of mass 6 kg moves in a circle of circumference (6π) m with a constant speed of 10 m/s, so the centripetal force that acts on the body is
- (a) 50 N (b) 180 N (c) 200 N (d) 400 N

19 * An object of mass 5 kg moves in a horizontal circle of radius 2 m at a constant linear speed of 5 m/s, so:

(i) The centripetal acceleration with which the body moves equals

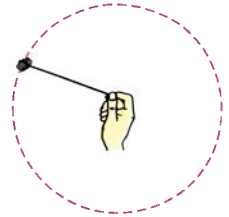
- (a) 10 m/s^2 (b) 2.5 m/s^2 (c) 12.5 m/s^2 (d) 50 m/s^2

(ii) The centripetal force acting on the body equals

- (a) 12.5 N (b) 60.6 N (c) 62.5 N (d) 80.5 N

20 In the opposite figure, a stone of mass 0.25 kg is tied to the end of a string of length 0.5 m and rotates in a horizontal circle at constant speed. If the tension force in the string is 160 N, the stone speed is

- (a) 8.9 m/s (b) 17.9 m/s
(c) 20.3 m/s (d) 320 m/s



21 In the opposite figure, a man of mass 50 kg rides a bicycle along a curved road of radius 30 m with a speed of 2 m/s. If the centripetal force that acts on both the man and the bicycle is 10 N, so the mass of the bicycle is

- (a) 100 kg (b) 75 kg (c) 50 kg (d) 25 kg



22 * An object of weight 100 N moves with a speed of 10 m/s in a horizontal circular path of radius 10 m, if the acceleration due to gravity is 10 m/s^2 ; (Take: $\pi = 3.14$)

(i) The centripetal acceleration equals

- (a) 1 m/s^2 (b) 5 m/s^2 (c) 10 m/s^2 (d) 20 m/s^2

(ii) The centripetal force equals

- (a) 50 N (b) 60 N (c) 80 N (d) 100 N

(iii) The elapsed time to complete two revolutions equals

- (a) 6.23 s (b) 10.78 s (c) 11.67 s (d) 12.56 s

23 A toy airplane of mass 100 g moves in a uniform circular motion on a path with a radius of 1 m and completes 10 revolutions within 20 s. So: (Given that: $\pi = 3.14$)

(i) The tangential velocity equals

- (a) 1.02 m/s (b) 3.14 m/s (c) 3.58 m/s (d) 2.06 m/s

(ii) The centripetal acceleration is approximately equal to

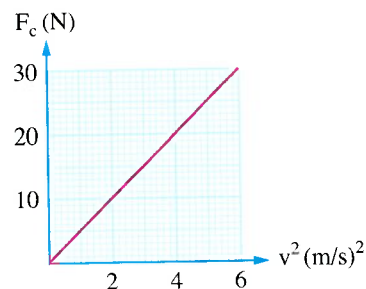
- (a) 3.14 m/s^2 (b) 4.21 m/s^2 (c) 9.86 m/s^2 (d) 10.25 m/s^2

(iii) The centripetal force equals

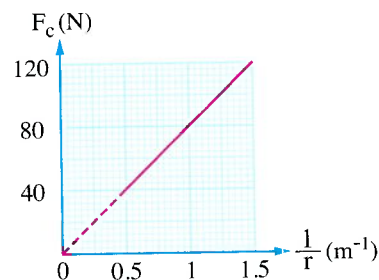
- (a) 0.242 N (b) 0.553 N (c) 0.704 N (d) 0.986 N

- 24 * If the centripetal force that keeps a car moving in a horizontal circular roadway of radius 500 m equals 0.08 of the car's weight, the maximum speed at which the car can move on that road without sliding outside the edge of the road equals (Take: $g = 10 \text{ m/s}^2$)
- (a) 10 m/s (b) 20 m/s (c) 40 m/s (d) 400 m/s

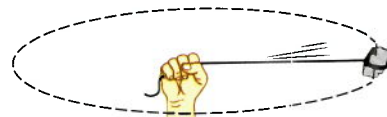
- 25 * A body of mass m moves in a circular path of radius 2 m and the opposite graph shows the relation between the centripetal force (F_c) required to keep the body moving in the circular path and the square of its tangential velocity (v^2), hence the mass of the body (m) equals



- (a) 2.5 kg (b) 5 kg
(c) 10 kg (d) 720 kg
- 26 A body of mass 5 kg moves several times in uniform horizontal circular paths with varying radii with a constant linear speed (v), and the opposite graph shows the relationship between the centripetal force (F_c) acting on the body to maintain its circular motion in each path and the reciprocal of the path radius ($\frac{1}{r}$), so the magnitude of the linear speed (v) of the body equals

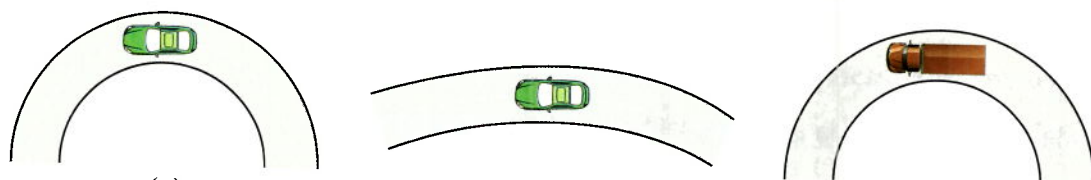


- (a) 0.25 m/s (b) 2 m/s (c) 4 m/s (d) 16 m/s
- 27 In the opposite figure, a stone of mass 600 g is tied to a thread of length 10 cm. If the stone rotates in a horizontal circle at a uniform speed of 3 m/s;



- (i) The centripetal force equals
- (a) 18 N (b) 32 N (c) 54 N (d) 540 N
- (ii) What do you expect to happen if the thread can't withstand a tension more than 30 N?
- (a) The thread relaxes and the centripetal force decreases to become 30 N.
(b) The thread doesn't break and the stone continues to move in the same circular path but with a lower speed.
(c) The thread breaks and the stone moves at the moment of breaking the thread towards the center of the circular path.
(d) The thread breaks and the stone moves at the moment of breaking the thread tangent to the circular path.

- 28  A body is moving with speed v in a horizontal circular path, so to increase the radius of the path to four times its original value, the centripetal force required for the body to move with the same speed (v) in its new circular path will
 (a) be halved (b) remain unchanged (c) be doubled (d) be quartered
- 29 The ratio between the centripetal forces acting on two bodies of equal masses, if the first body moves with a speed of 5 m/s in a horizontal circle of diameter 4 m and the second body moves with a speed of 10 m/s in a horizontal circle of diameter 8 m equals
 (a) $\frac{1}{2}$ (b) $\frac{1}{3}$ (c) $\frac{1}{4}$ (d) $\frac{2}{3}$
- 30  The following figure shows three vehicles a, b and c of masses m , m , $3m$ respectively moving with the same speed in three horizontal curved roadways of diameters of curvature d , $2d$, d respectively, so the correct order of these vehicles according to their possibility of going into a skid is



- (a) $b < a < c$ (b) $a < b < c$ (c) $c < a < b$ (d) $c < b < a$

Second Essay Questions

- 1  When whirling a stone attached to the end of a string in a horizontal circular path at constant speed. **What** is the direction of the force acting on it that keeps it moving in its circular path? **What** is the direction of the stone's motion at the instant the string breaks?
- 2 **Explain the following statements:**
- (1)  Although a body moving in a uniform circular motion has an acceleration, its linear speed is constant.
 - (2) The Earth continues to rotate around the Sun in the same orbit.
 - (3) • When a car negotiates a horizontal curved road at an appropriate speed, it maintains its curved path and does not skid.
 • A car does not skid when moving in a horizontal curved path at an appropriate speed.
 - (4) The centripetal force does no work on the body which moves in a circular path.
 - (5) When designing road curves, we must take into account the maximum centripetal force.

- 3 The driving instructor assured that the trainees should decrease the speed of the car before entering a curved road to maintain the safety of the car and driver. From your study of the circular motion, **what is the reason of this?**
- 4 A car starts its motion in a curved slippery road, where the driver notices that the car skids out of the curved road. **Explain.**
- 5 **What are the results of** the small diameters of the curves in the highways on the moving cars on them?

Questions that measure **high levels of thinking**

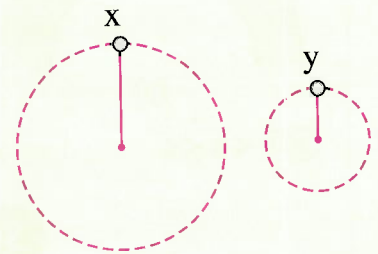
Answered in detail

Choose the correct answer:

- 1 In the opposite figure, two balls (x and y) are identical, each of them is tied to a thread. If the two balls undergo uniform circular motions of the same periodic time in a horizontal plane where the radius of the path of ball x is two times as large as that of ball y, the ratio between the tension forces in the two balls' threads $\left(\frac{F_x}{F_y}\right)$ equals

(a) $\frac{1}{2}$
(c) $\frac{2}{1}$

(b) $\frac{1}{4}$
(d) $\frac{4}{1}$



Answer the following question:

- 2 In the opposite figure, which point on the Earth's surface has the largest linear velocity relative to the Earth's axis of rotation? Is it the point that is located on the Equator or on the Tropics of Capricorn and Cancer? **And why?**



Questions

Chapter 5

Answered

Universal Gravitation and Circular Motion

First

Multiple Choice Questions

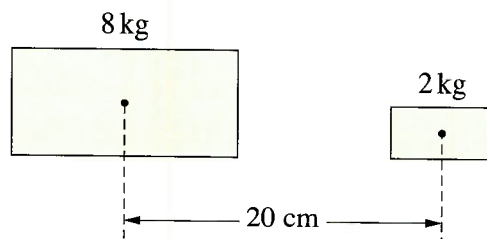
Questions signed by * are answered in detail.

Interactive test



► Law of universal gravitation:

- 1 * In the opposite figure, two bodies of masses 2 kg and 8 kg are at a distance of 20 cm away from each other, given that the universal gravitational constant equals $6.67 \times 10^{-11} \text{ N.m}^2/\text{kg}^2$, so the gravitational mutual force between them equals



- (a) $2.67 \times 10^{-8} \text{ N}$ (b) $2.67 \times 10^{-12} \text{ N}$ (c) $5.34 \times 10^{-9} \text{ N}$ (d) $5.34 \times 10^{-11} \text{ N}$

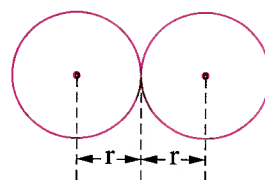
- 2 * Two balls have the same mass, if the distance between their centers is 2 m and the attraction force between them is $6.67 \times 10^{-9} \text{ N}$, the mass of each ball equals
(Take: $G = 6.67 \times 10^{-11} \text{ N.m}^2/\text{kg}^2$)

- (a) 14.14 kg (b) 20 kg (c) 200 kg (d) 400 kg

- 3 Two balls have masses of 8 kg and 20 kg, the distance between their centers is 0.2 m, if the universal gravitational constant is G , so the gravitational mutual force between them in newtons equals

- (a) $8G$ (b) $40G$ (c) $4000G$ (d) $8000G$

- 4 In the opposite figure, two similar balls, each of mass m and radius r are placed in contact with each other, then the magnitude of the mutual attraction force between them is given by the relation



- (a) $F = \frac{Gm^2}{r^2}$ (b) $F = \frac{Gm^2}{4r^2}$ (c) $F = \frac{2Gm}{r^2}$ (d) $F = \frac{Gm^2}{2r^2}$

- 5 The measuring unit of the universal gravitational constant is

- (a) N.m.kg (b) $\text{N.m}^2/\text{kg}$ (c) $\text{m}^3.\text{kg}/\text{s}^2$ (d) $\text{m}^3/\text{kg.s}^2$

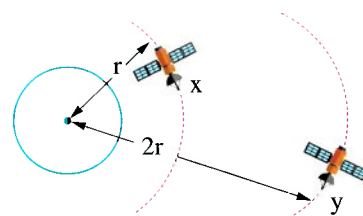
- 6 If the distance between the centers of two bodies is doubled while keeping their masses constant, the mutual attraction force between them will be

(a) doubled (b) halved (c) quartered (d) quadrupled

- 7 Two bodies of masses m_1 and m_2 were placed near to each other such that the distance between their centers was r . If the mass of the first body gets doubled and also the distance between their centers gets doubled, the mutual attraction force between them will

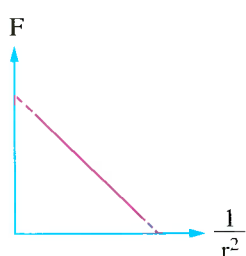
(a) not change (b) be doubled (c) be halved (d) be quadrupled

- 8 The opposite diagram shows two satellites x and y orbiting a planet, so if the magnitudes of attraction forces between the planet and each of the two satellites are equal, the ratio between the masses of the two satellites ($\frac{m_x}{m_y}$) is

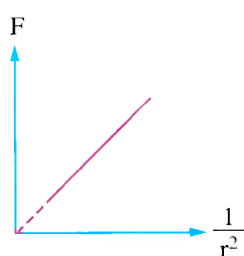


(a) $\frac{1}{1}$ (b) $\frac{1}{2}$ (c) $\frac{1}{4}$ (d) $\frac{4}{1}$

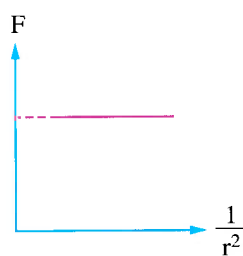
- 9 The graph that represents the variation of the force of gravitation (F) between two bodies versus the reciprocal of the distance between their centers squared ($\frac{1}{r^2}$) is



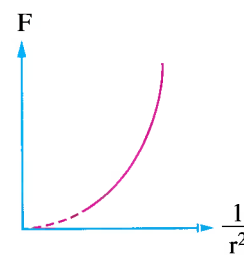
(a)



(b)

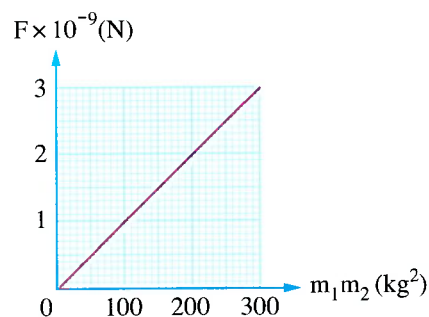


(c)



(d)

- 10 There are several bodies of different masses, the gravitational force between each pair of them was determined separately while keeping the distance between their centers constant, the opposite graph represents the variation of the mutual gravitational force (F) between two bodies versus the product of their masses ($m_1 m_2$), so the distance (r) between the centers of the two bodies equals



(Take: $G = 6.67 \times 10^{-11} \text{ N.m}^2/\text{kg}^2$)

(a) 1.84 m (b) 2.58 m (c) 4.62 m (d) 5.78 m

كيفية طباعة صفحات معينة من ملف معين مثلا ازاي نطبع الصفحات من صفحة 4 الى صفحة 9



حمل الآن

مجاناً وحصرياً

المراجعة رقم (3)

اختبار شهر ابريل



**Chapter 3| Light interference and diffraction**

(1) The wavelength λ of any monochromatic light in Thomas Young's double-slit experiment is determined from the relation:

a) $\lambda = \frac{\Delta y R}{d}$

b) $R = \frac{\Delta y d}{\lambda}$

c) $\Delta y = \frac{\lambda d}{R}$

d) $d = \frac{\lambda \Delta y}{R}$

(2) In the phenomenon of light interference in Young's experiment, bright fringes are formed between dark fringes.

The central bright fringe is formed as a result of the interference between

- a) The second crest of the first source with the second crest of the second source.
- b) The first trough of the first source with the first crest of the second source.
- c) The second crest of the first source with the third crest of the second source.
- d) The first crest of the first source with the third crest of the second source.

(3) If the distance of the first bright fringe from the central fringe in Young's experiment is 2 cm, then the distance of the third dark fringe from the central fringe is

- a) 2 cm
- b) 5 cm
- c) 6 cm
- d) 7 cm

(4) In Young's experiment, monochromatic light of wavelength $5000 \text{ \AA}$ is used.

The distance between the two slits is 0.3 mm, and the distance between two successive bright fringes is 5 mm.

The distance between the double slit and the screen where the interference pattern appears is

- a) 9 m
- b) 12 m
- c) 3 m
- d) 6 m



- (5) In Young's experiment, when the distance between the double slit and the screen is doubled, the distance between two successive fringes of the same type
- a) Doubles and the clarity of the fringes decreases.
 - b) Doubles and the clarity of the fringes increases.
 - c) Becomes half and the clarity of the fringes increases.
 - d) Becomes half and the clarity of the fringes decreases.
- (6) In Young's experiment, a monochromatic light ray is used and the distance between the slits is d_1 , then the double slit is replaced with another double slit whose separation is half the original distance.
so, the distance between two successive fringes of the same type in the second case is ...
- a) $\Delta y_2 = \frac{\Delta y_1}{2}$
 - b) $\Delta y_2 = \Delta y_1$
 - c) $\Delta y_2 = 4\Delta y_1$
 - d) $\Delta y_2 = 2\Delta y_1$
- (7) In Young's experiment, if the distance of the fourth dark fringe from the central fringe is X, then the distance between the central fringe and the first bright fringe equals
- a) $\frac{X}{4.5}$
 - b) $\frac{X}{4}$
 - c) $\frac{X}{3.5}$
 - d) $\frac{X}{3}$
- (8) The ratio between the distance from the central fringe to the first bright fringe when using red light and when using violet light in Young's experiment is:
- a) Greater than one
 - b) Less than one
 - c) Equal to one
 - d) Equal to zero



(9) The area of the Airy disk in a light diffraction experiment increases when

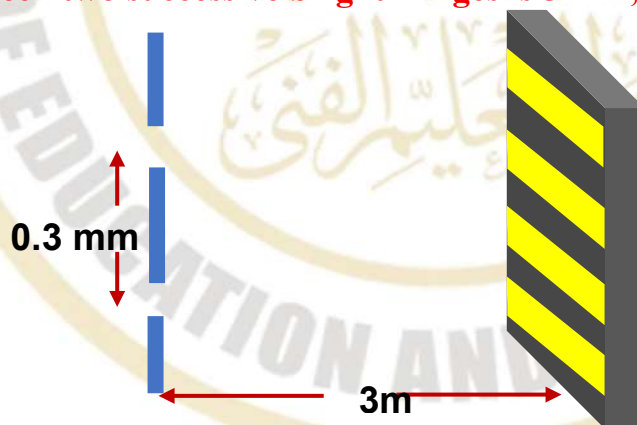
- a) The screen is moved closer to the circular aperture.
- b) Monochromatic light with a higher frequency is used.
- c) The diameter of the circular aperture increases.
- d) The diameter of the circular aperture decreases.

(10) Which of the following properties of the ray changes when diffraction occurs?

- a) Speed
- b) Wavelength
- c) Frequency
- d) Direction

Second: Essay

(1) From the diagram shown in front of you of Young's double-slit experiment, if the distance between two successive bright fringes is 5 mm, calculate the wavelength of the light used.



(3) In Young's double-slit experiment, the distance between the slits is A , the distance between the slits and the observation screen is X , and a monochromatic light source of wavelength λ is used.

If the light source is replaced with another source of wavelength 2.4λ ,

Calculate the new distance between the slits and the observation screen in terms of X in order to keep the interference pattern unchanged.

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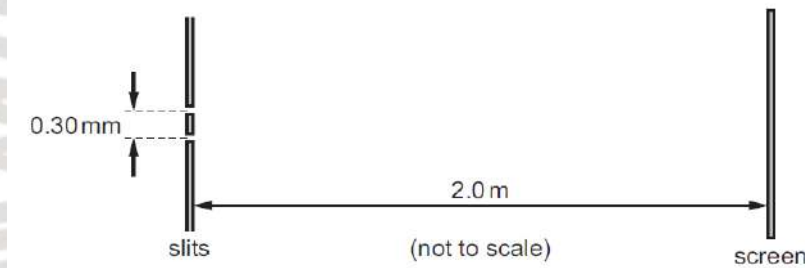
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(4) Monochromatic light with a wavelength of 450 nm passes through two parallel slits separated by 0.3 mm. The bright fringes are observed on a screen 2 m away. Calculate the distance (in millimeters) between two successive fringes of the same type.



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- The end -

(1) The wavelength λ of any monochromatic light in Thomas Young's double-slit experiment is determined from the relation:

~~a) $\lambda = \frac{\Delta y R}{d}$~~

$$b) R = \frac{\Delta y d}{\lambda}$$

~~c) $\Delta y = \frac{\lambda d}{R}$~~

~~d) $d = \frac{\lambda \Delta y}{R}$~~

$$\Delta y = \frac{\lambda R}{d}$$

$$d = \frac{\lambda R}{\Delta y}$$

$$\lambda = \frac{\Delta y d}{R}$$

$$R = \frac{\Delta y d}{\lambda}$$

λ	R
Δy	d

(2) In the phenomenon of light interference in Young's experiment, bright fringes are formed between dark fringes.

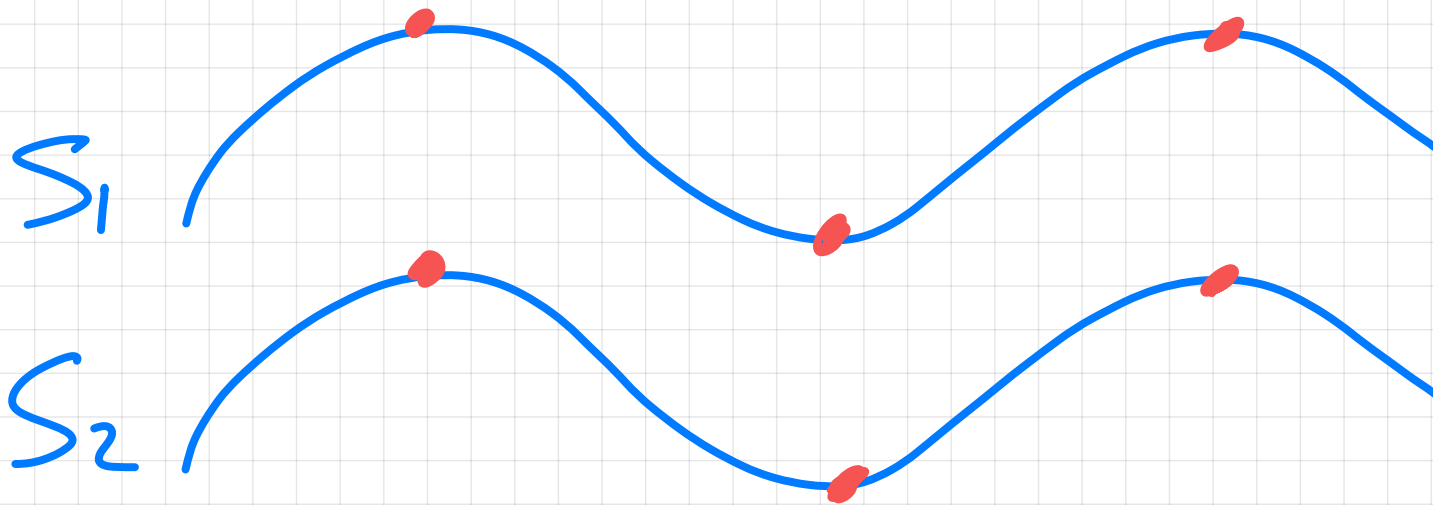
The central bright fringe is formed as a result of the interference between

a) The second crest of the first source with the second crest of the second source.

~~b) The first trough of the first source with the first crest of the second source.~~

~~c) The second crest of the first source with the third crest of the second source.~~

~~d) The first crest of the first source with the third crest of the second source.~~



(3) If the distance of the first bright fringe from the central fringe in Young's experiment is 2 cm, then the distance of the third dark fringe from the central fringe is

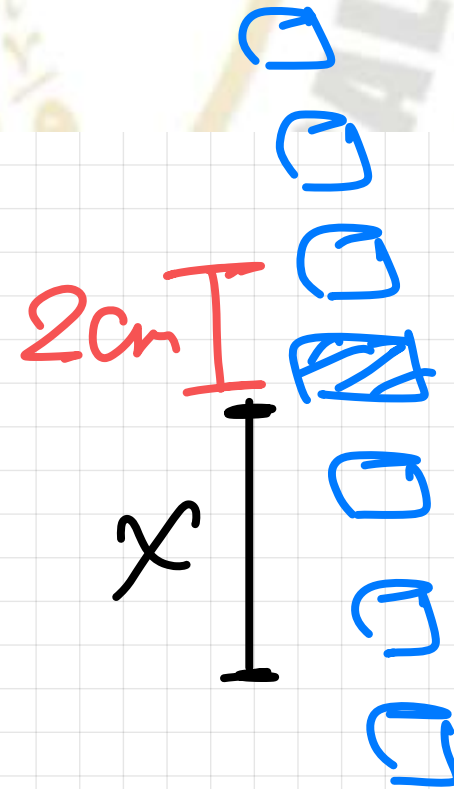
- a) 2 cm
- b) 5 cm
- c) 6 cm
- d) 7 cm

$$\Delta y = 2 \text{ cm}$$

$$n = 2.5$$

$$\Delta y = \frac{\lambda}{n} \rightarrow 5 \text{ cm}$$

2 2.5



(4) In Young's experiment, monochromatic light of wavelength $5000 \text{ \AA}$ is used.

The distance between the two slits is 0.3 mm , and the distance between two successive bright fringes is 5 mm .

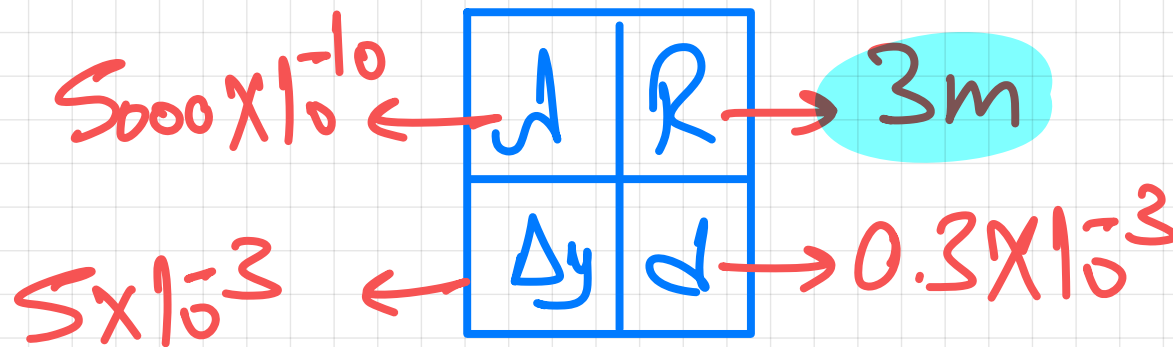
The distance between the double slit and the screen where the interference pattern appears is

a) 9 m

b) 12 m

c) 3 m

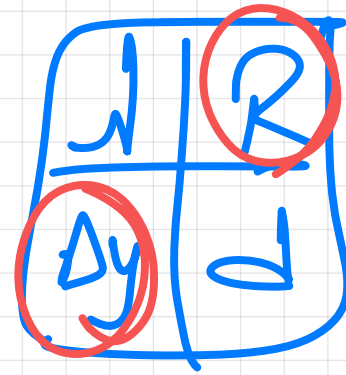
d) 6 m



(5) In Young's experiment, when the distance between the double slit and the screen is **doubled**, the distance between two successive fringes of the same type

- ~~a) Doubles and the clarity of the fringes decreases.~~
- b) Doubles and the clarity of the fringes increases.**
- ~~c) Becomes half and the clarity of the fringes increases.~~
- ~~d) Becomes half and the clarity of the fringes decreases.~~

$$R \rightarrow 2 \quad \Delta y$$



(6) In Young's experiment, a monochromatic light ray is used and the distance between the slits is d_1 , then the double slit is replaced with another double slit whose separation is half the original distance.

so, the distance between two successive fringes of the same type in the second case is ...

~~a) $\Delta y_2 = \frac{\Delta y_1}{2}$~~

~~c) $\Delta y_2 = 4\Delta y_1$~~

~~b) $\Delta y_2 = \Delta y_1$~~

d) $\Delta y_2 = 2\Delta y_1$

$$d_1 = d$$

$$d_2 = \frac{1}{2}d$$

$$\Delta y$$

λ	R
Δy	d

$$\frac{\Delta y_1}{\Delta y_2} = \frac{d_2}{d_1} = \frac{\frac{1}{2}d}{d} = \frac{1}{2}$$

$$\Delta y_2 = 2\Delta y_1$$

(7) In Young's experiment, if the distance of the fourth dark fringe from the central fringe is X , then the distance between the central fringe and the first bright fringe equals

a) $\frac{X}{4.5}$

b) $\frac{X}{4}$

c) $\frac{X}{3.5}$

d) $\frac{X}{3}$

$$n_1 = 3.5$$

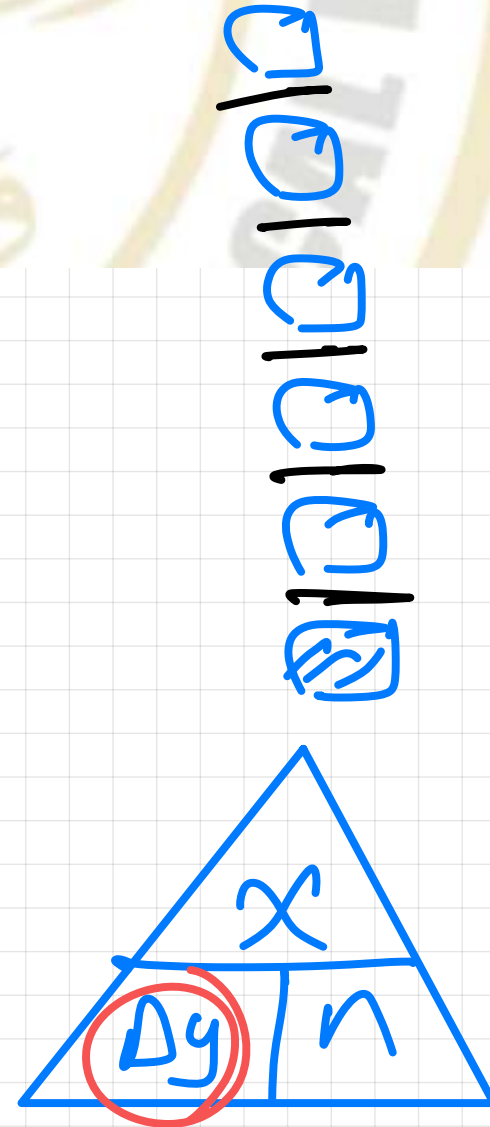
$$X_1 = X$$

$$n_2 = 1$$

$$X_2 =$$

$$X \leftarrow \frac{X_1}{X_2} = \frac{n_1}{n_2} \rightarrow 3.5$$

$$\frac{2}{7}X \leftarrow X_2 \quad n_2 \rightarrow 1$$



(8) The ratio between the distance from the central fringe to the first bright fringe when using red light and when using violet light in Young's experiment is:

- a) Greater than one
- b) Less than one
- c) Equal to one
- d) Equal to zero

 Δy

λ	R
Δy	λ

$$\lambda_R > \lambda_V$$

$$\Delta y_R > \Delta y_V$$

(9) The area of the Airy disk in a light diffraction experiment increases when

- ~~a) The screen is moved closer to the circular aperture.~~
- ~~b) Monochromatic light with a higher frequency is used.~~
- ~~c) The diameter of the circular aperture increases.~~
- d) The diameter of the circular aperture decreases.

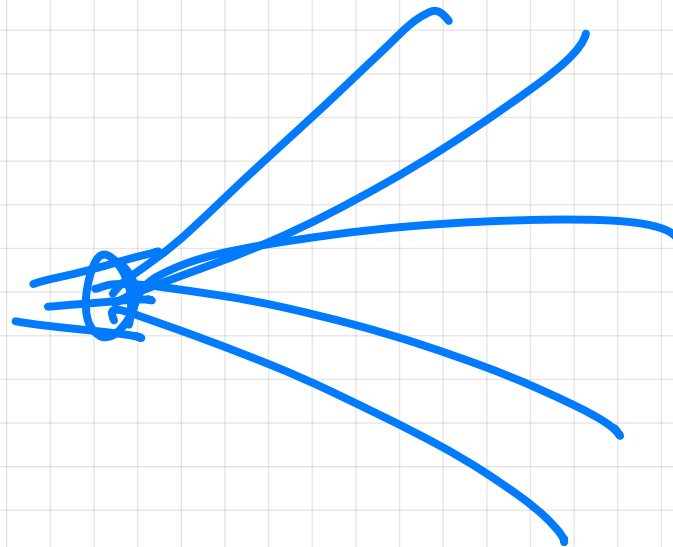
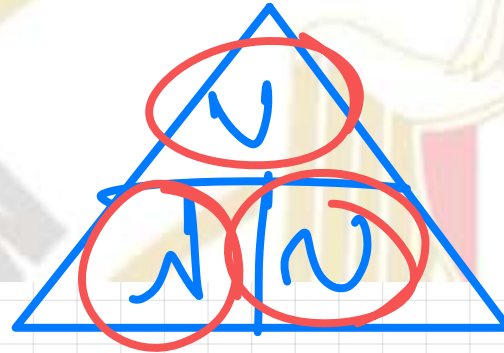
$\uparrow \lambda > d \downarrow$

$\downarrow d$

$\uparrow R$

(10) Which of the following properties of the ray changes when diffraction occurs?

- ~~a) Speed~~
- ~~b) Wavelength~~
- ~~c) Frequency~~
- d) Direction



Second: Essay

(1) From the diagram shown in front of you of Young's double-slit experiment, if the distance between two successive bright fringes is 5 mm, calculate the wavelength of the light used.



$$\lambda = 500 \text{ nm} = 5 \times 10^{-7} \text{ m}$$

(3) In Young's double-slit experiment, the distance between the slits is A , the distance between the slits and the observation screen is X , and a monochromatic light source of wavelength λ is used.

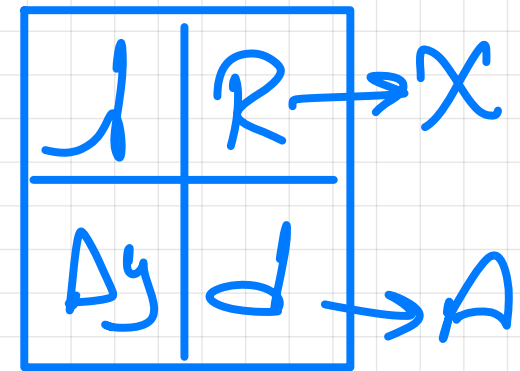
If the light source is replaced with another source of wavelength 2.4λ ,

Calculate the new distance between the slits and the observation screen in terms of X in order to keep the interference pattern unchanged.

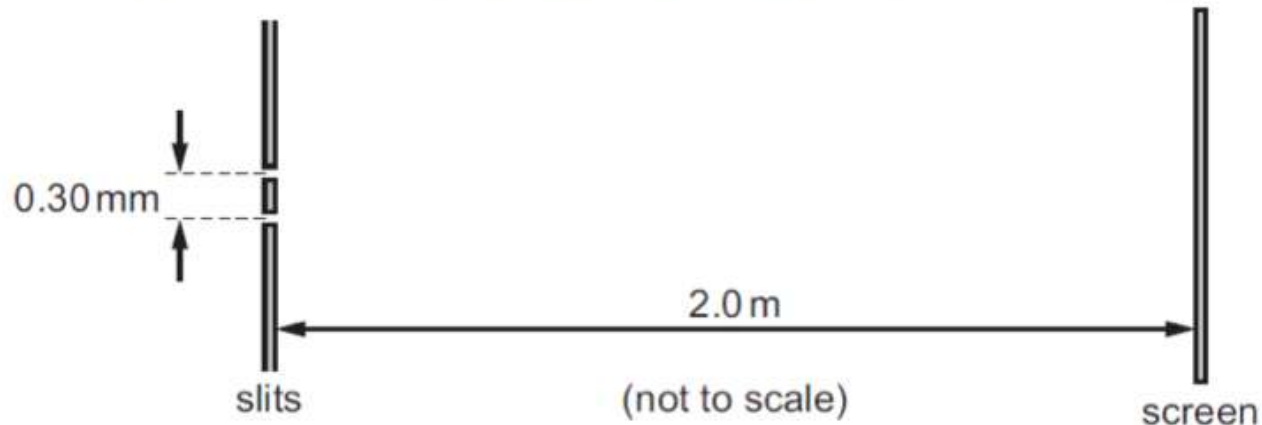
$$\lambda_1 = \lambda$$

$$\lambda_2 = 2.4\lambda$$

$$\frac{\lambda_1}{\lambda_2} = \frac{R_2}{R_1} \Rightarrow \frac{\lambda}{2.4\lambda} = \frac{R_2}{R_1} \Rightarrow \frac{R_2}{R_1} = \frac{1}{2.4}$$



- (4) Monochromatic light with a wavelength of 450 nm passes through two parallel slits separated by 0.3 mm . The bright fringes are observed on a screen 2 m away. Calculate the distance (in millimeters) between two successive fringes of the same type.



$$\Delta y = \frac{0.003}{10^{-3}} = 3 \text{ mm}$$

$$450 \times 10^{-9}$$

λ	R	$\rightarrow 2$
Δy	d	$\rightarrow 0.3 \times 10^{-3}$

**Chapter 3| Total Internal Reflection of Light****First: MCQ**

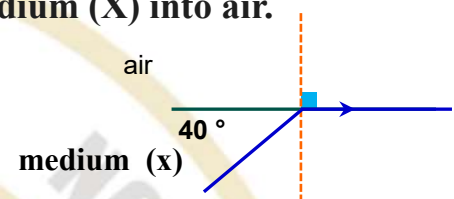
[1] For total internal reflection to occur for a ray incident from a medium of higher optical density to a medium of lower optical density, the angle of incidence must be

- [A] Equal to zero or a right angle [B] Greater than the critical angle
[C] Less than the critical angle [D] Equal to the critical angle

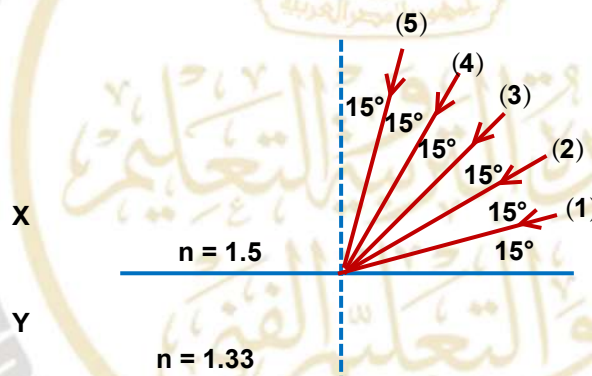
[2] The figure shows the transition of a light ray from medium (X) into air.

The speed of light in medium (X) is equal to

- [A] 1.4×10^8 m/s [B] 2.7×10^8 m/s
[C] 1.92×10^8 m/s [D] 2.3×10^8 m/s



[3] Light rays are incident from medium (X) with a refractive index of 1.5 to medium (Y) with a refractive index of 1.33. The rays are separated by equal angles of 15° each.



How many of these rays can pass through (refract) into medium (Y)?

- [A] Four [B] Two [C] Three [D] Five

[4] The ray that has the largest critical angle when passing from water to air is the:

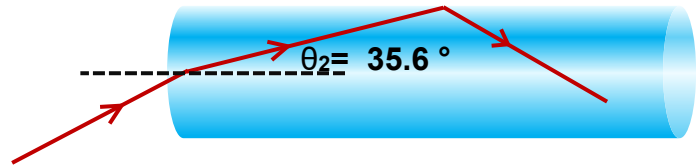
- [A] Violet ray [B] Blue ray [C] Yellow ray [D] Green ray

[5] If $n_{\text{glass}} > n_{\text{water}} > n_{\text{benzene}}$, then the ratio of the critical angle between glass and benzene to the critical angle between c and benzene is

- [A] Less than one [B] Greater than one
[C] Cannot be determined [D] Equal to one

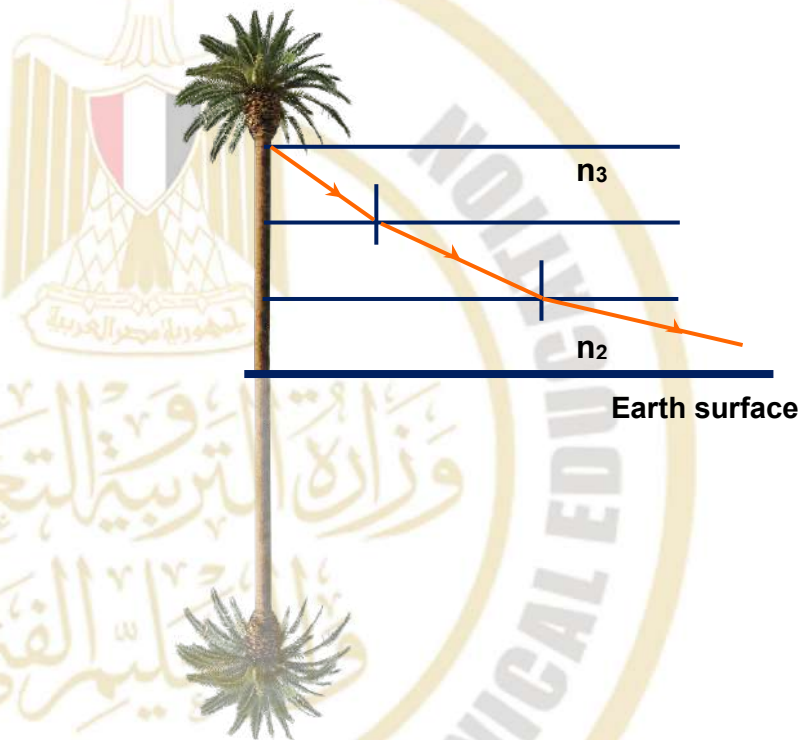
[6] The figure shows an optical fiber where the critical angle of its material is 51.4° . The angle of incidence of the light ray from the air is

- [A] 48.1°
- [B] 54.4°
- [C] 51.4°
- [D] 35.6°



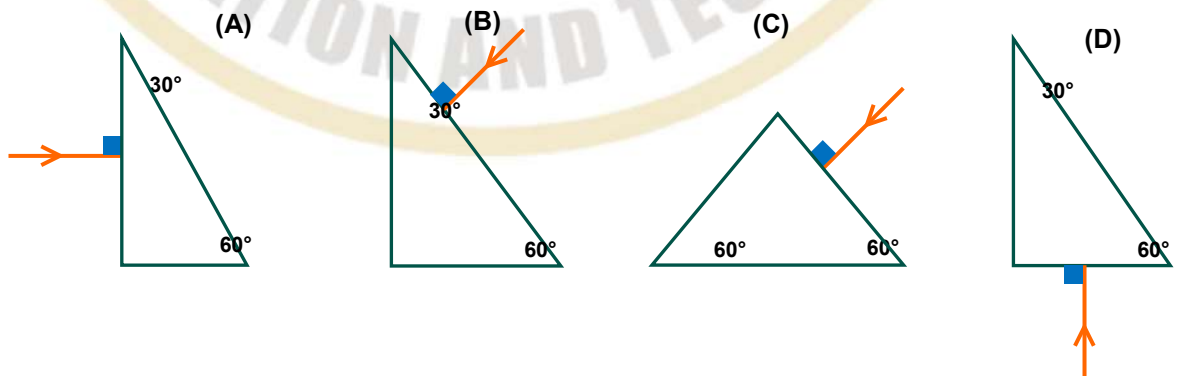
[7] The figure shows an image of a palm tree on the ground. In order to see the inverted image, the order of the wavelength of light in the three air layers must be:

- [A] $\lambda_3 > \lambda_2 > \lambda_1$
- [B] $(\lambda_3 = \lambda_1) > \lambda_2$
- [C] $\lambda_3 = \lambda_2 = \lambda_1$
- [D] $\lambda_3 < \lambda_2 < \lambda_1$



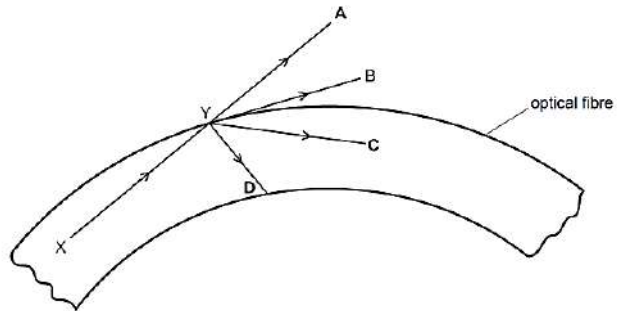
[8] If the refractive index for glass is $n = 1.5$, which of the following figures show the incident ray undergoing total internal reflection?

- [A] B, C
- [B] D, C
- [C] A, C
- [D] B, A



(9) A light ray travels from point X to point Y along the optical fiber. The angle of incidence at point Y is greater than the critical angle. In which direction does the light ray travel after reaching point Y?

- [A] A
- [B] B
- [C] C
- [D] D



(10) If the speed of light in media X and Y are $2.4 \times 10^8 \text{ m/s}$ and $1.8 \times 10^8 \text{ m/s}$ respectively, then the critical angle between the two media is

- [A] 48.59° and it is located in medium X
- [B] 48.59° and it is located in medium Y
- [C] 53.13° and it is located in medium X
- [D] 53.13° and it is located in medium Y

(11) Why is light able to maintain its intensity in optical fiber cables?

- [A] Because the exit angle is very small relative to the materials used.
- [B] Because the critical angle with air is not equal on both sides.
- [C] Because optical fibers undergo total internal reflection.
- [D] Because the cable materials do not come into contact with air.

(12) The mirage effect occurs due to

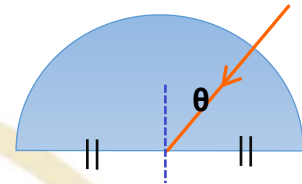
- [A] Light rays reaching your eyes faster.
- [B] Water on the road.
- [C] Water evaporation.
- [D] Differences in air temperatures.

Second: Essay

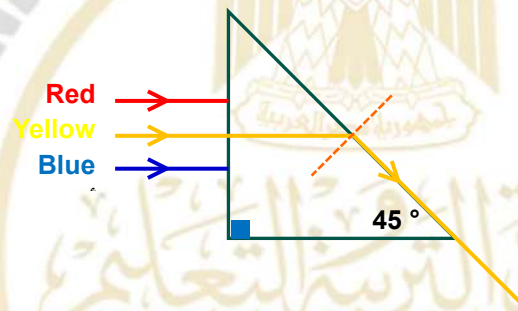
(13) In the opposite figure: A light ray is incident on a glass semi-disk. Trace the path of the ray if:

(a) $\theta = 45^\circ$

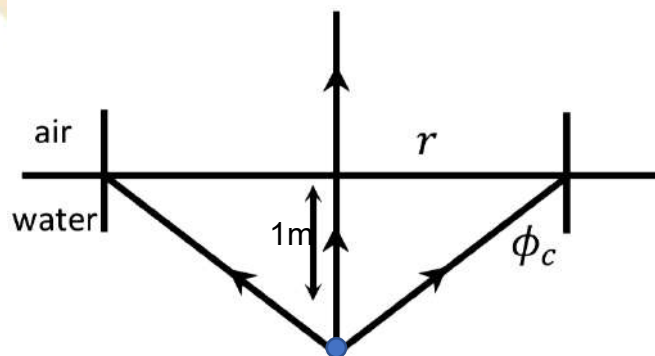
(b) $\theta = 60^\circ$



(14) In the figure, three rays are incident on a prism. The yellow ray emerged tangent to the opposite face. Illustrate by drawing the paths of the red and blue rays.



(15) A luminous object is located at the bottom of a tank containing water with a refractive index of ($n = 4/3$). The water depth is 1 meter, and light rays spread in all directions, forming a circular spot of light on the water surface. Calculate the radius of this light circle on the water surface.





Weekly Assessment

Week (8)

Chapter 3 | Total Internal Reflection of Light

Group (A)

First: Multiple Choice

[1] Can total internal reflection occur when light travels from a medium of lower density to a medium of higher optical density?

- [A] Yes, because the angle of total reflection depends on the angle of incidence.
- [B] No, because the angle of incidence cannot be large enough.
- [C] Yes, because light refracts away from the normal.
- [D] No, because light refracts toward the normal.

[2] When light travels from a medium of higher optical density to a medium of lower optical density, the maximum value for the angle of refraction in the lower density medium is

- [A] 180°
- [B] 90°
- [C] 45°
- [D] 42°

[3] We may not be able to see the bottom of a swimming pool when looking at it from the air due to the occurrence of

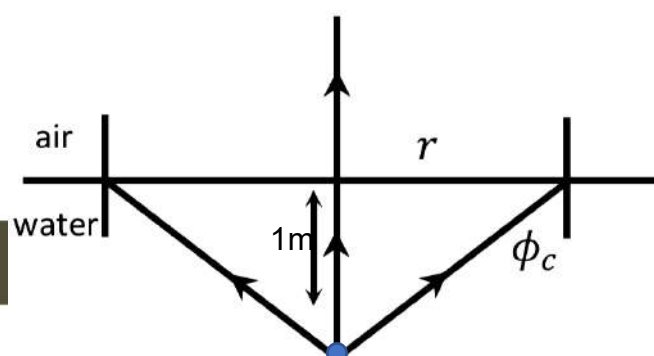
- [A] Light interference.
- [B] Light diffraction.
- [C] Light refraction.
- [D] Total internal reflection.

[4] When a lamp is lit under the surface of the water, a bright spot appears on the water surface in the shape of a circle due to

- [A] Total internal reflection.
- [B] Light diffraction.
- [C] Light interference.
- [D] Difference in the periodic time.

Second: Essay

(5) A luminous object is located at the bottom of a tank containing water with a refractive index of ($n = 4/3$). The water depth is 1 meter, and light rays spread in all directions, forming a circular spot of light on the water surface. Calculate the radius of this light circle on the water surface.





Group (B)

First: Multiple Choice

- [1] Total internal reflection of light occurs when rays travel from the medium:
- [A] Higher density medium with an angle of incidence greater than the critical angle.
 - [B] Higher density medium with an angle of incidence less than the critical angle.
 - [C] Lower density medium with an angle of incidence less than the critical angle.
 - [D] Lower density medium with an angle of incidence greater than the critical angle.

[2] If a light ray is incident from glass with a refractive index n onto the surface separating it from air at an angle 45° , then this ray

- [A] Passes through, refracting at an angle greater than 45° .
- [B] Undergoes total internal reflection at an angle 45° .
- [C] Passes through, refracting at an angle smaller than 45° .
- [D] Emerges tangent to the boundary surface between glass and air.

[3] As the temperature difference between the air layers in contact with the ground and the layers above them increases, the chance of total internal reflection occurring

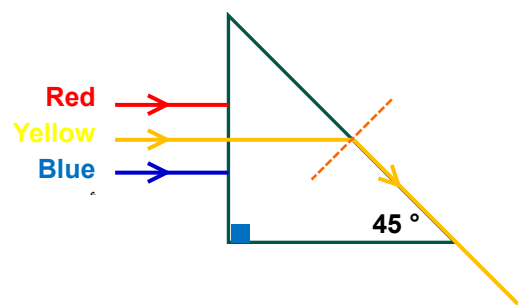
- [A] Increases.
- [B] Decreases.
- [C] Does not change.
- [D] Becomes zero.

[4] In an optical fiber, the refractive index of the core material is

- [A] Larger or smaller than the cladding material depending on the angle of incidence.
- [B] Less than the refractive index of the cladding material.
- [C] Equal to the refractive index of the cladding material.
- [D] Always greater than the refractive index of the cladding material.

Second: Essay

(5) In the figure, three rays are incident on a prism. The yellow ray emerged tangent to the opposite face. Illustrate by drawing the paths of the red and blue rays.



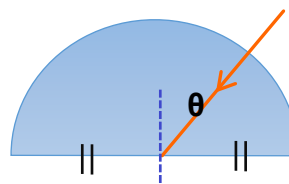
First: Multiple Choice

- [1] The critical angle between two media depends on
- [A] Only the absolute refractive index of the medium with higher optical density.
- [B] Only the absolute refractive index of the medium with lower optical density.
- [C] The absolute refractive index of both media.
- [D] The angle of incidence of the light ray on the interface between the two media.
-
- [2] A thick-walled container made of a transparent material with a refractive index of 1.52 contains a liquid with a refractive index of 1.44. The critical angle between them is
- [A] 71.33° and it is located in the container material.
- [B] 68.42° and it is located in the container material.
- [C] 71.33° and it is located in the liquid.
- [D] 68.42° and it is located in the liquid.
-
- [3] In optical fiber cables, why is light able to maintain its intensity?
- [A] Because the exit angle is very small relative to the materials used.
- [B] Because the critical angle with air is not equal at both ends.
- [C] Because optical fibers have total internal reflection.
- [D] Because the cable materials do not come into contact with air.
-
- [4] The mirage effect is due to
- [A] The fastest light rays reaching your eyes first.
- [B] Water on the road.
- [C] Water evaporation.
- [D] Differences in air temperature.

Second: Essay Questions

(5) In the opposite figure: A light ray is incident on a glass semi-disk. Trace the path of the ray if:

- (a) $\theta = 45^\circ$
- (b) $\theta = 60^\circ$



[1] For total internal reflection to occur for a ray incident from a medium of higher optical density to a medium of lower optical density, the angle of incidence must be

~~[A] Equal to zero or a right angle~~

~~[C] Less than the critical angle~~

[B] Greater than the critical angle

~~[D] Equal to the critical angle~~

$\theta < \theta_c \rightarrow \text{Refraction}$

$\theta = \theta_c \rightarrow \theta = 90^\circ$

$\theta > \theta_c \rightarrow \text{T.I.R.}$

[2] The figure shows the transition of a light ray from medium (X) into air.

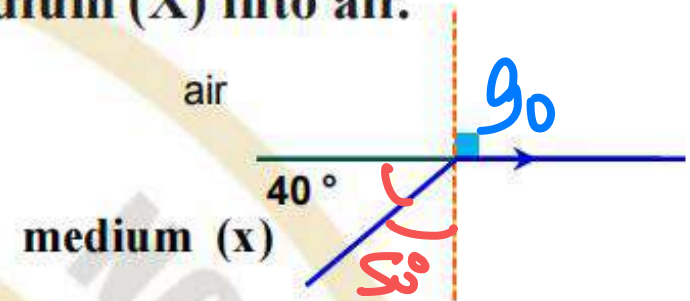
The speed of light in medium (X) is equal to

[A] $1.4 \times 10^8 \text{ m/s}$

[B] $2.7 \times 10^8 \text{ m/s}$

[C] $1.92 \times 10^8 \text{ m/s}$

[D] $2.3 \times 10^8 \text{ m/s}$



$$\frac{2.298 \times 10^8}{3 \times 10^8} V_x \leftarrow \frac{V_1}{V_2} = \frac{\sin \phi}{\sin \theta} \rightarrow \frac{50}{40}$$

[3] Light rays are incident from medium (X) with a refractive index of 1.5 to medium (Y) with a refractive index of 1.33. The rays are separated by equal angles of 15° each.

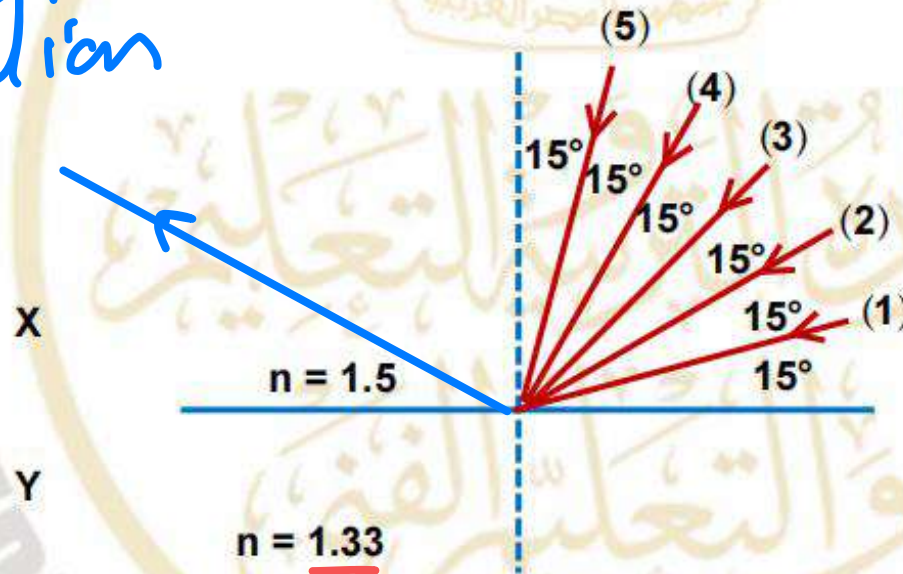
⑤ Refraction

④

③

②

① T.I.R



$$\sin \phi_c = \frac{1.33}{1.5}$$

$$\phi_c = 62.45^\circ$$

How many of these rays can pass through (refract) into medium (Y)?

[A] Four

[B] Two

[C] Three

[D] Five

[4] The ray that has the largest critical angle when passing from water to air is the:

☒ [A] Violet ray

☐ [B] Blue ray

☐ [C] Yellow ray

☐ [D] Green ray

$$n \propto f \propto \frac{1}{v} \propto \frac{1}{\theta} \propto \frac{1}{\lambda} \propto \frac{1}{\theta_c}$$

R o y G B I V



[5] If $n_{\text{glass}} > n_{\text{water}} > n_{\text{benzene}}$, then the ratio of the critical angle between glass and benzene to the critical angle between c and benzene is

[A] Less than one

[C] Cannot be determined

Water

[B] Greater than one

[D] Equal to one

$$\sin \theta_{c1} = \frac{n_b}{n_g}$$

$$\sin \theta_{c2} = \frac{n_b}{n_w}$$

$$\frac{\sin \theta_{c1}}{\sin \theta_{c2}} = \frac{\cancel{n_b}}{n_g} \times \frac{n_w}{\cancel{n_b}} = \frac{n_w}{n_g} < 1$$

[6] The figure shows an optical fiber where the critical angle of its material is 51.4°. The angle of incidence of the light ray from the air is

[A] 48.1°

[B] 54.4°

[C] 51.4°

[D] 35.6°



$$\sin 51.4 = \frac{1}{n} \Rightarrow n = 1.28$$

$$1.28 \leftarrow n_2 = \frac{\sin \phi}{\sin \theta} \rightarrow 48.15^\circ$$

$$1 \leftarrow n_1 \rightarrow 35.6$$

[7] The figure shows an image of a palm tree on the ground. In order to see the inverted image, the order of the wavelength of light in the three air layers must be:

[A] $\lambda_3 > \lambda_2 > \lambda_1$

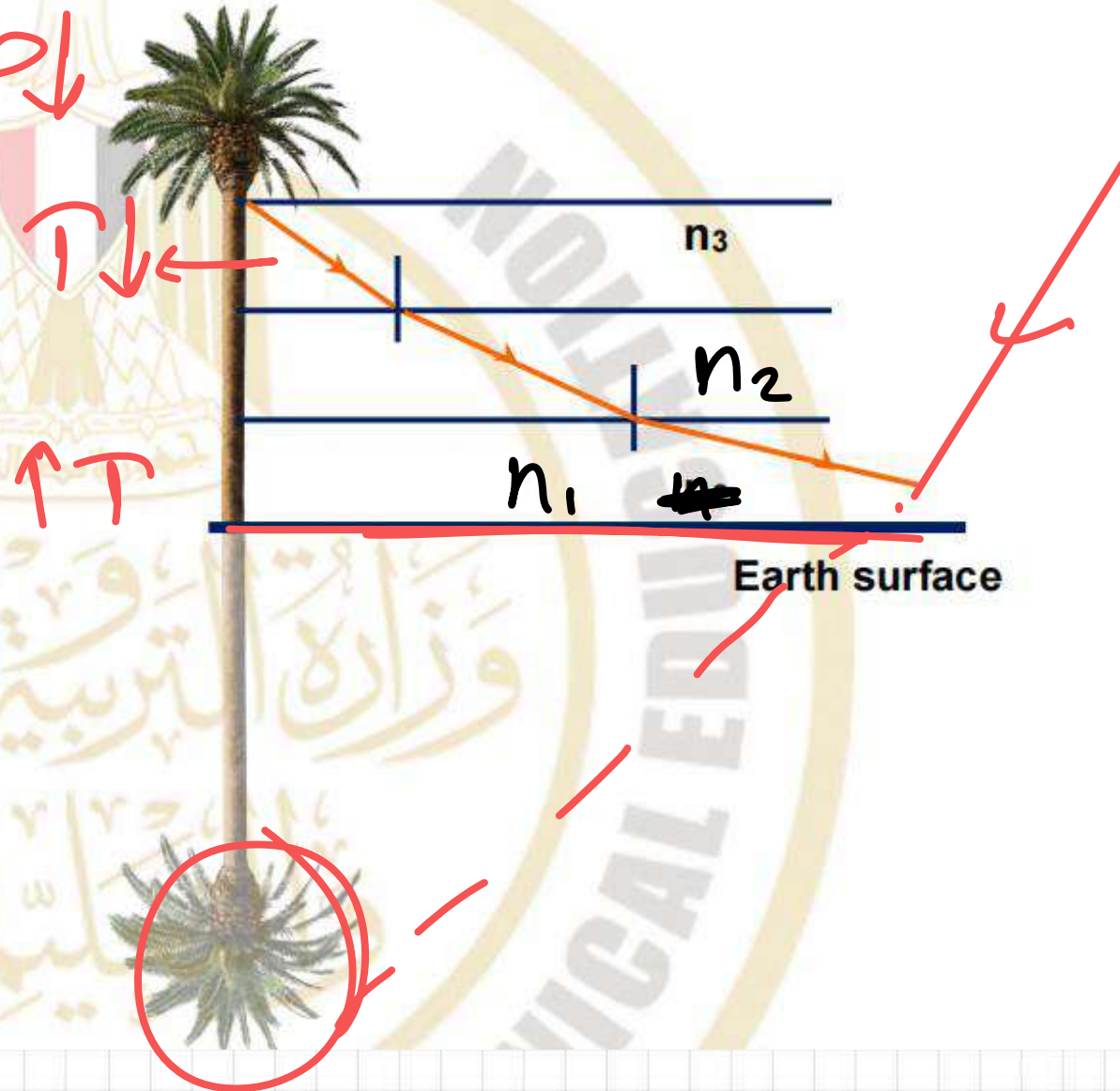
[B] $(\lambda_3 = \lambda_1) > \lambda_2$

[C] $\lambda_3 = \lambda_2 = \lambda_1$

[D] $\lambda_3 < \lambda_2 < \lambda_1$

$$P \propto \frac{1}{v} \propto \frac{1}{\lambda} \propto \frac{1}{T}$$

$$T_1 > T_2 > T_3$$



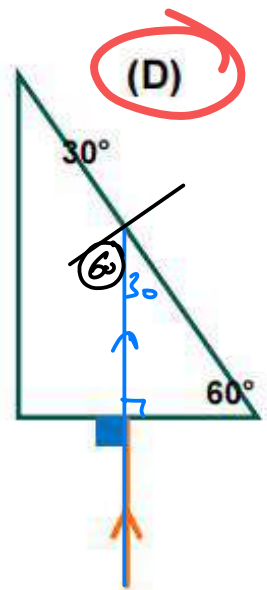
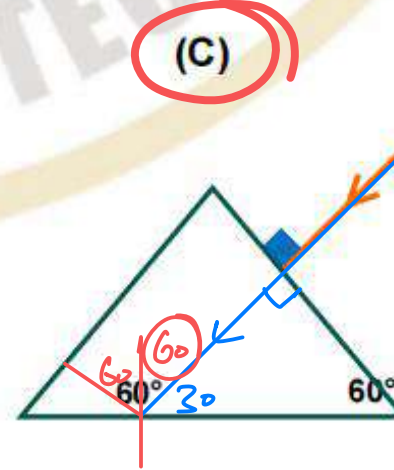
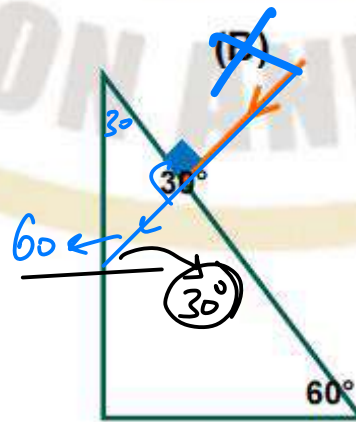
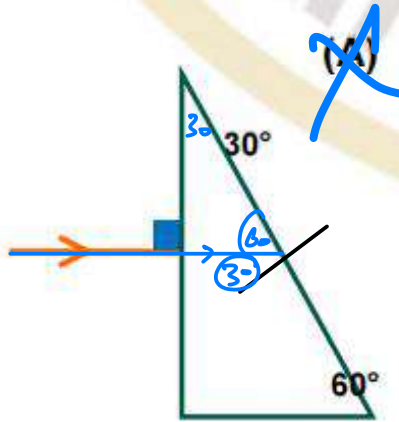
[8] If the refractive index for glass is $n = 1.5$, which of the following figures show the incident ray undergoing total internal reflection?

~~[A] B, C~~

[B] D, C

~~[C] A, C~~

~~[D] B, A~~



$$\sin \phi_c = \frac{1}{1.5} \Rightarrow \phi_c = 41.8$$

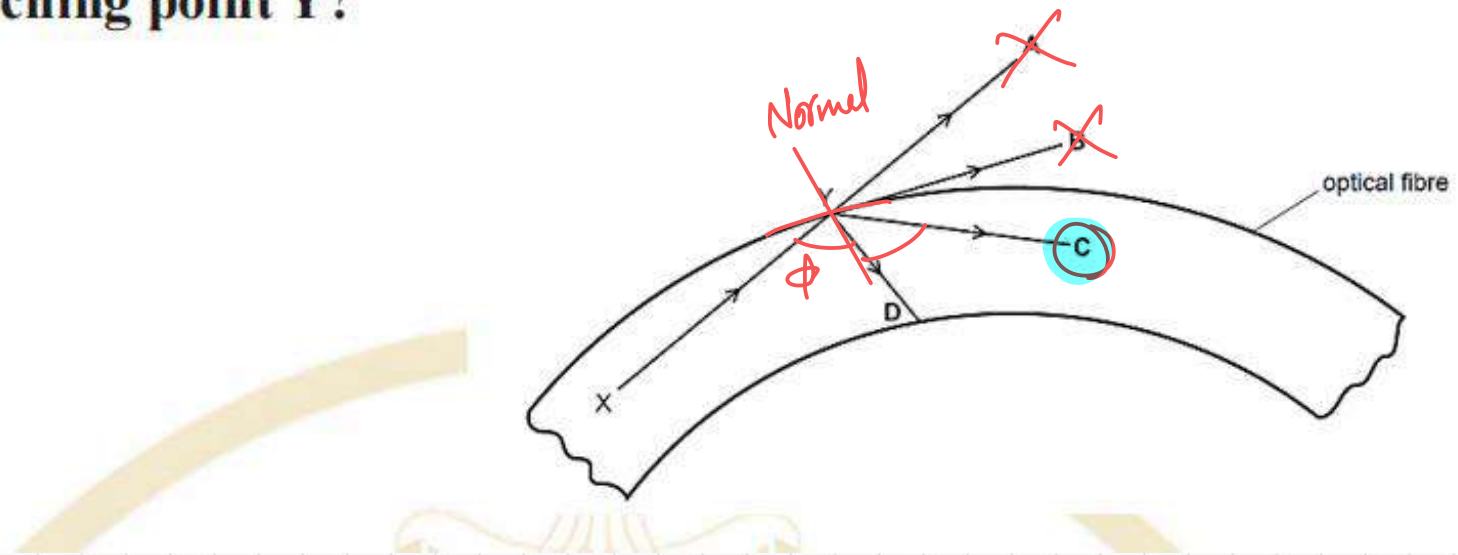
(9) A light ray travels from point X to point Y along the optical fiber. The angle of incidence at point Y is greater than the critical angle. In which direction does the light ray travel after reaching point Y?

[A] A

[B] B

[C] C

[D] D



(10) If the speed of light in media X and Y are $2.4 \times 10^8 \text{ m/s}$ and $1.8 \times 10^8 \text{ m/s}$ respectively, then the critical angle between the two media is

~~[A] 48.59° and it is located in medium X~~

[B] 48.59° and it is located in medium Y

~~[C] 53.13° and it is located in medium X~~

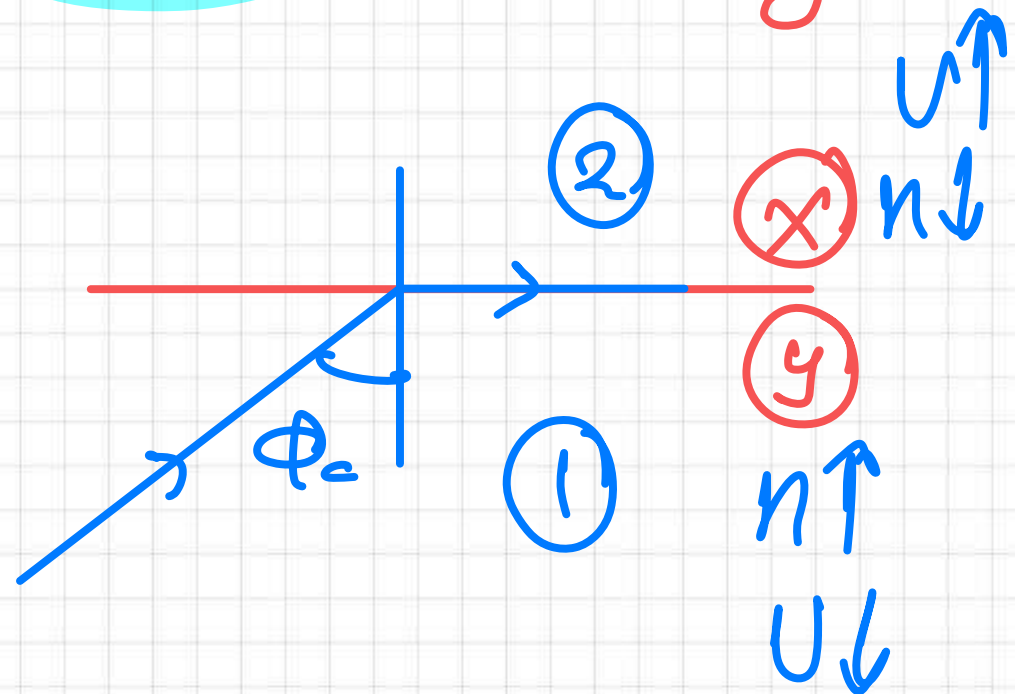
~~[D] 53.13° and it is located in medium Y~~

$$\sin \phi_c = \frac{n_x}{n_y} = \frac{v_y}{v_x} \Rightarrow 48.59^\circ$$

$$n_x < n_y$$

$$v_x > v_y$$

$$n \propto \frac{1}{v}$$



(11) Why is light able to maintain its intensity in optical fiber cables?

☒ [A] Because the exit angle is very small relative to the materials used.

☒ [B] Because the critical angle with air is not equal on both sides.

☐ [C] Because optical fibers undergo total internal reflection.

☒ [D] Because the cable materials do not come into contact with air.



(12) The mirage effect occurs due to

~~[A]~~ Light rays reaching your eyes faster.

~~[B]~~ Water on the road.

~~[C]~~ Water evaporation.

[D] Differences in air temperatures.

$$n \propto \rho \propto \frac{1}{T} \propto \frac{1}{V} \propto \frac{1}{h} \propto \frac{1}{\theta_c}$$

Second: Essay

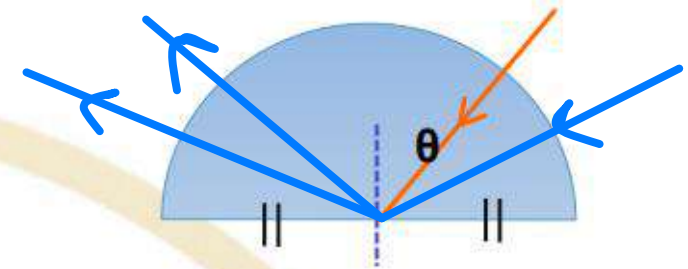
(13) In the opposite figure: A light ray is incident on a glass semi-disk. Trace the path of the ray if:

$$n = 1.5$$

(a) $\theta = 45^\circ$

(b) $\theta = 60^\circ$

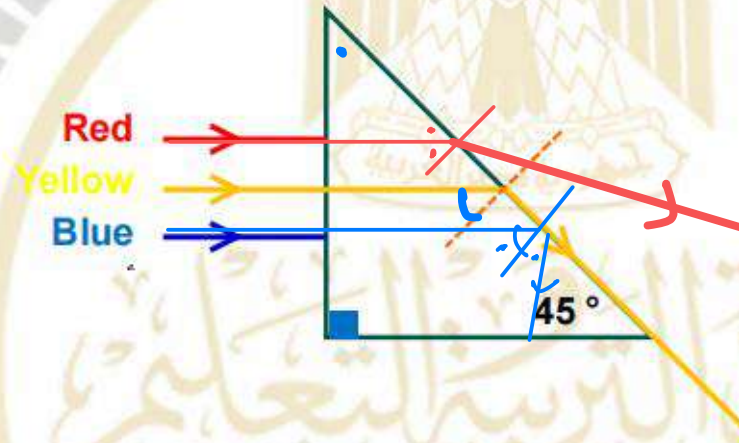
$\rightarrow$ T.I.R



$$\sin \phi_c = \frac{1}{1.5} \Rightarrow \phi_c = 41.8^\circ$$

(14) In the figure, three rays are incident on a prism. The yellow ray emerged tangent to the opposite face. Illustrate by drawing the paths of the red and blue rays.

$$\lambda \propto \phi_c$$



$$\phi_{cy} = 45$$

$$\phi = 45 < \phi_c$$

$$\phi = 45 > \phi_c$$

$$\lambda_R > \lambda_y > \lambda_B$$

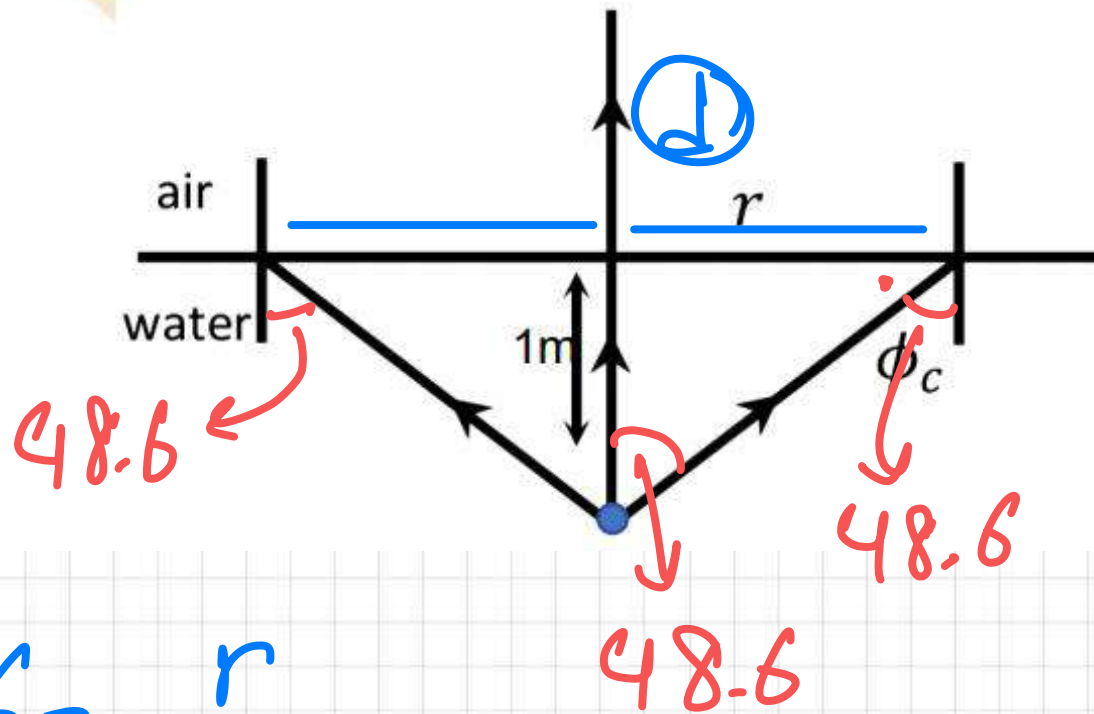
$$\phi_{cR} > \phi_{cy} > \phi_{cB}$$

$$50 > 45 > 40$$

Red $\rightarrow$ Refraction

Blue $\rightarrow$ T.I.R

(15) A luminous object is located at the bottom of a tank containing water with a refractive index of ($n = 4/3$). The water depth is 1 meter, and light rays spread in all directions, forming a circular spot of light on the water surface. Calculate the radius of this light circle on the water surface.



$$\sin \phi_c = \frac{1}{4/3}$$

$$\phi_c = 48.6$$

$$\tan 48.6 = \frac{r}{1}$$

$$r = 1.13 \text{ m}$$

$$D = 2.26 \text{ m}$$

Group (A)

First: Multiple Choice

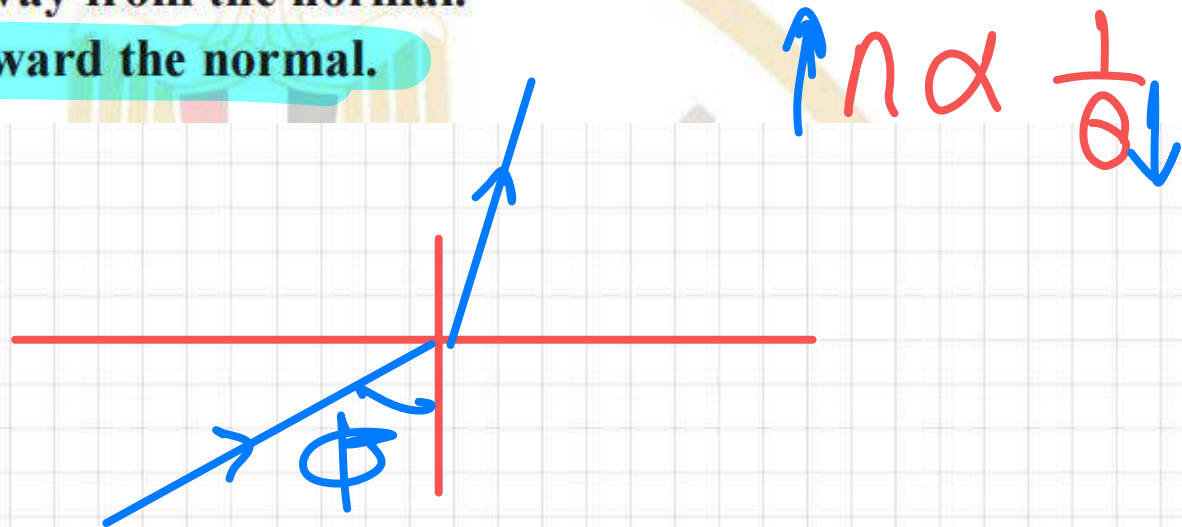
[1] Can total internal reflection occur when light travels from a medium of lower density to a medium of higher optical density?

~~[A] Yes, because the angle of total reflection depends on the angle of incidence.~~

~~[B] No, because the angle of incidence cannot be large enough.~~

~~[C] Yes, because light refracts away from the normal.~~

[D] No, because light refracts toward the normal.



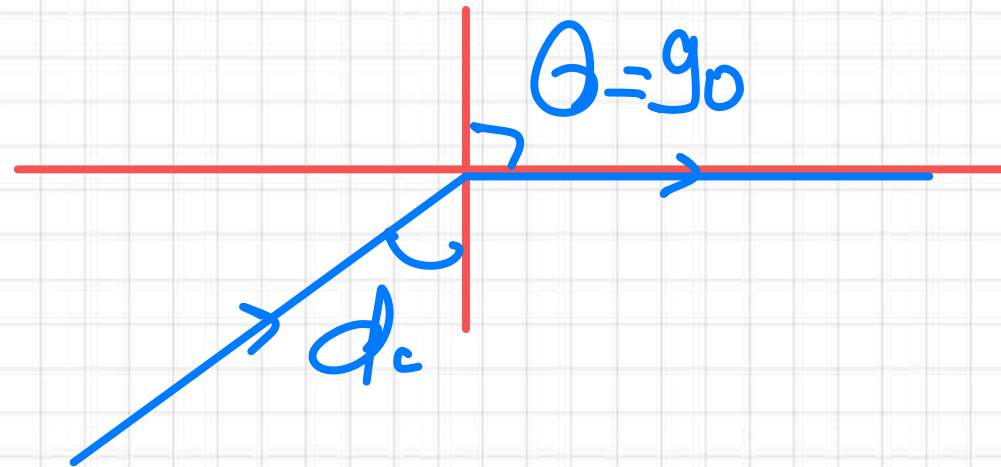
[2] When light travels from a medium of higher optical density to a medium of lower optical density, the maximum value for the angle of refraction in the lower density medium is

[A] 180°

[B] 90°

[C] 45°

[D] 42°



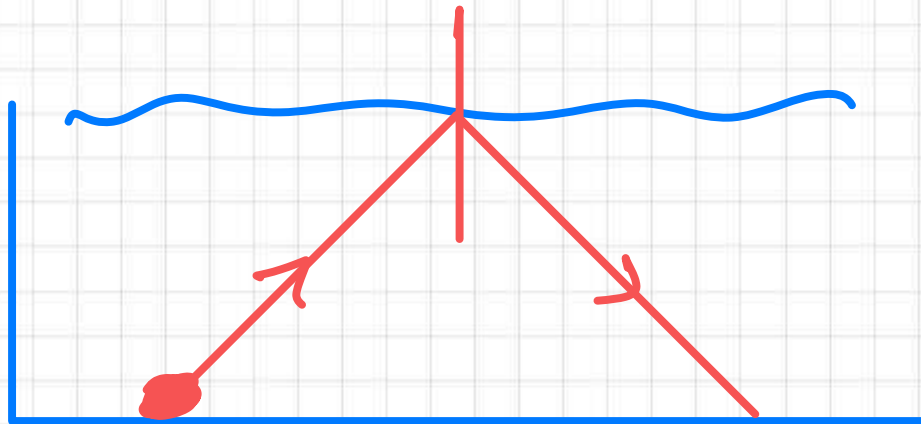
[3] We may not be able to see the bottom of a swimming pool when looking at it from the air due to the occurrence of

~~[A] Light interference.~~

~~[C] Light refraction.~~

~~[B] Light diffraction.~~

[D] Total internal reflection.



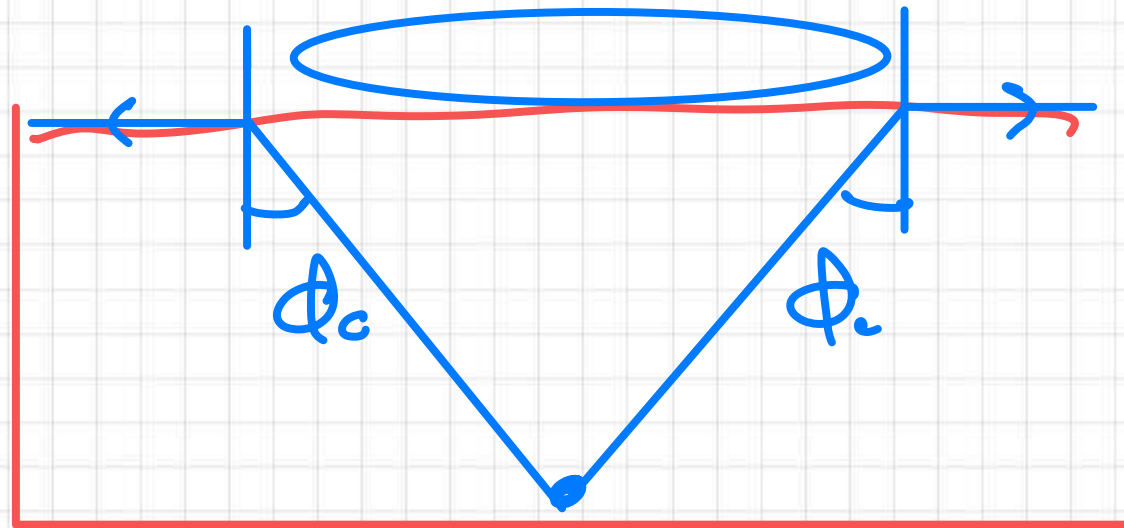
[4] When a lamp is lit under the surface of the water, a bright spot appears on the water surface in the shape of a circle due to

[A] Total internal reflection.

[B] Light diffraction.

[C] Light interference.

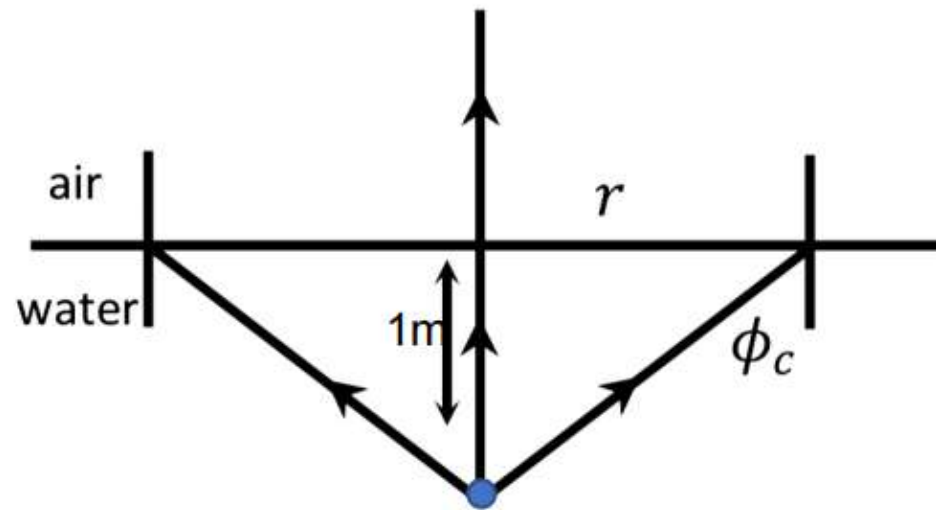
[D] Difference in the periodic time.



Second: Essay

(5) A luminous object is located at the bottom of a tank containing water with a refractive index of ($n = 4/3$). The water depth is 1 meter and light rays spread in all directions, forming a circular spot of light on the water surface. Calculate the radius of this light circle on the water surface.

Q15



First: Multiple Choice

[1] Total internal reflection of light occurs when rays travel from the medium:

[A] Higher density medium with an angle of incidence greater than the critical angle.

~~[B] Higher density medium with an angle of incidence less than the critical angle.~~

~~[C] Lower density medium with an angle of incidence less than the critical angle.~~

~~[D] Lower density medium with an angle of incidence greater than the critical angle.~~

[2] If a light ray is incident from glass with a refractive index n onto the surface separating it from air at an angle 45° then this ray

~~[A]~~ Passes through, refracting at an angle greater than 45° .

[B] Undergoes total internal reflection at an angle 45° .

~~[C]~~ Passes through, refracting at an angle smaller than 45° .

~~[D]~~ Emerges tangent to the boundary surface between glass and air.

$n = 1.5$

$$\sin \theta_c = \frac{1}{1.5} \Rightarrow \boxed{\theta_c = 41.8}$$

[3] As the temperature difference between the air layers in contact with the ground and the layers above them increases, the chance of total internal reflection occurring

[A] Increases.

[B] Decreases.

[C] Does not change.

[D] Becomes zero.

$$T \propto v \propto \phi_c$$

[4] In an optical fiber, the refractive index of the core material is

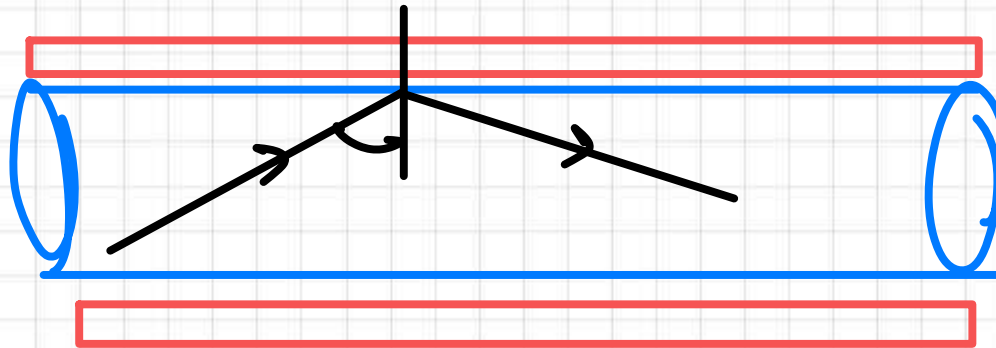
~~[A] Larger or smaller than the cladding material depending on the angle of incidence.~~

~~[B] Less than the refractive index of the cladding material.~~

~~[C] Equal to the refractive index of the cladding material.~~

[D] Always greater than the refractive index of the cladding material.

$$\theta > \theta_c \downarrow$$



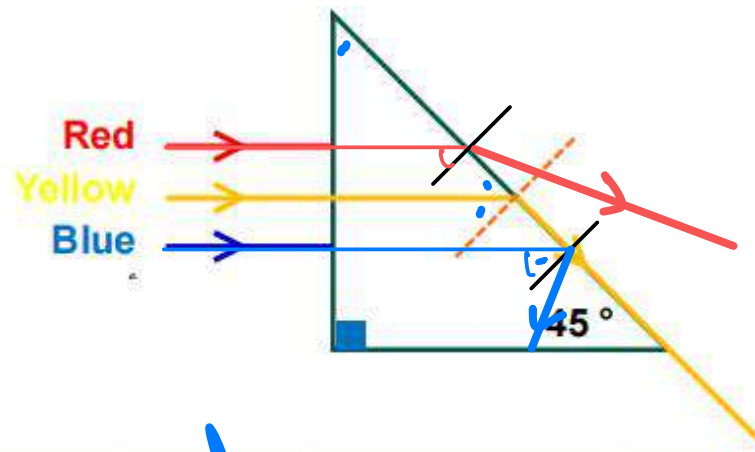
$$\sin \theta_c = \frac{n_2}{n_1}$$

$n_2 \rightarrow$ cladding
 $n_1 \rightarrow$ Material

Second: Essay

(5) In the figure, three rays are incident on a prism. The yellow ray emerged tangent to the opposite face. Illustrate by drawing the paths of the red and blue rays.

$$\lambda \propto \phi_c$$



$$\phi_{cy} = 45$$

$$\phi = 45$$

$$\lambda_R > \lambda_y > \lambda_B$$

$$\phi_{cR} > \phi_{cy} > \phi_{cB}$$

$$47 > 45 > 40$$

$$\phi < \phi_c \rightarrow \text{Ref.}$$

$$\phi_B > \phi_c \rightarrow \text{T.T.R.}$$

First: Multiple Choice

[1] The critical angle between two media depends on

- ☒ [A] Only the absolute refractive index of the medium with higher optical density.
- ☒ [B] Only the absolute refractive index of the medium with lower optical density.
- ☒ [C] The absolute refractive index of both media.
- ☒ [D] The angle of incidence of the light ray on the interface between the two media.

$$\sin \theta_c = \frac{n_2}{n_1}$$

[2] A thick-walled container made of a transparent material with a refractive index of 1.52 contains a liquid with a refractive index of 1.44. The critical angle between them is

[A] 71.33° and it is located in the container material.

~~[B] 68.42° and it is located in the container material.~~

~~[C] 71.33° and it is located in the liquid.~~

~~[D] 68.42° and it is located in the liquid.~~

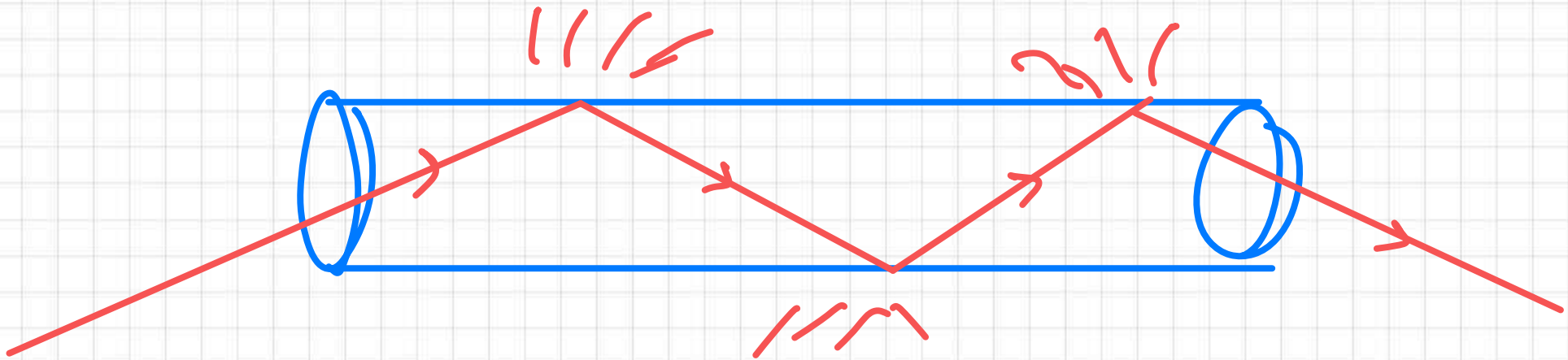
$$n_1 = 1.52$$

$$n_2 = 1.44$$

$$\sin \phi_c = \frac{n_2}{n_1} = \frac{1.44}{1.52} \Rightarrow \phi_c = 71.32^\circ$$

[3] In optical fiber cables, why is light able to maintain its intensity?

- ~~[A]~~ Because the exit angle is very small relative to the materials used.
- ~~[B]~~ Because the critical angle with air is not equal at both ends.
- [C] Because optical fibers have total internal reflection.
- ~~[D]~~ Because the cable materials do not come into contact with air.



[4] The mirage effect is due to

- ~~[A] The fastest light rays reaching your eyes first.~~
- ~~[B] Water on the road.~~
- ~~[C] Water evaporation.~~
- [D] Differences in air temperature.

Second: Essay Questions

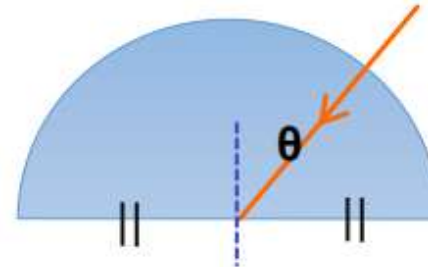
$$n = 1.5$$

(5) In the opposite figure: A light ray is incident on a glass semi-disk. Trace the path of the ray if:

(a) $\theta = 45^\circ$

(b) $\theta = 60^\circ$

T.T.R

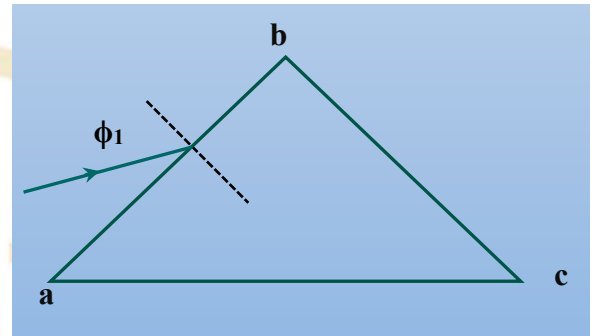


Chapter 3 | The Triangular Prism

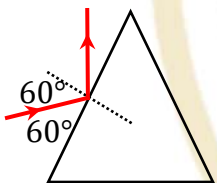
First: MCQ

[1] A triangular prism with refractive index (n_1) is placed in a liquid with refractive index (n_2), where ($n_1 < n_2$). The ray refracts to strike face BC and will:

- Undergo total internal reflection.
- Refract parallel to the separating surface.
- Refract toward the base.
- Refract away from the base.



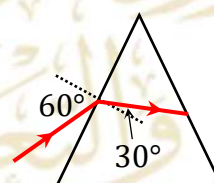
[2] A student drew the incident and refracted rays as shown in the figure, but the drawing was incorrect. For the path of the refracted ray to be correct, the figure should be modified to look like figure
(The refractive index of the prism material is ($n = \sqrt{3}$)).



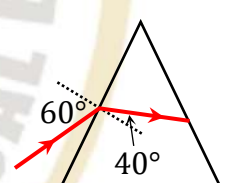
a)



b)



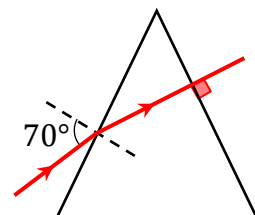
c)



d)

[3] The figure shows the path of a light ray incident on one face of a triangular prism with an apex angle of 38° . The ray emerges from the opposite face along its original direction. The angle of deviation of the light ray in the prism is:

- 30°
- 32°
- 38°
- 70°

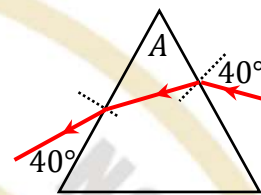


[4] A light ray is incident normally on one face of a triangular prism with an apex angle of 30° . If the refractive index of the prism material is $(\sqrt{2})$, then the angle of emergence from the prism equals:

- a) 0° b) 30° c) 45° d) 60°

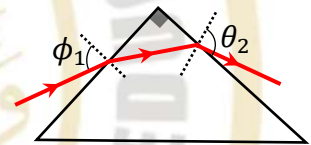
[5] A light ray is incident on one face of an equilateral triangular prism at an angle of 40° , and it emerges from the opposite face as shown in the figure. Therefore, the angle of deviation of the ray is equal to:

- a) 30°
b) 40°
c) 50°
d) 60°



[6] The figure shows a light ray incident at an angle (ϕ_1) on a triangular prism in the position of minimum deviation. If the refractive index of the prism material is 1.366, then the angle of emergence and the minimum angle of deviation, respectively, are:

- a) $45^\circ, 60^\circ$
b) $45^\circ, 75^\circ$
c) $60^\circ, 60^\circ$
d) $60^\circ, 75^\circ$

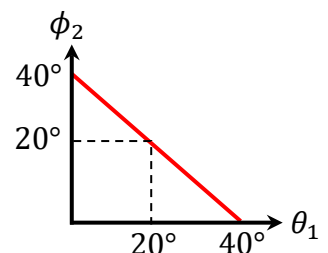


[7] When light is dispersed into its components by a triangular prism, violet light undergoes greater deviation than red light because:

- a) $n_{(\text{red})} > n_{(\text{violet})}$
b) $\lambda_{(\text{red})} > \lambda_{(\text{violet})}$
c) $v_{(\text{red})} > v_{(\text{violet})}$
d) $T_{(\text{red})} < T_{(\text{violet})}$

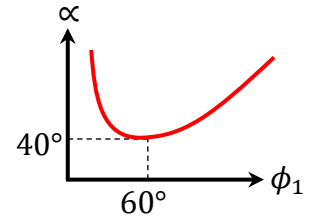
[8] The adjacent graph represents the relationship between the first angle of refraction (θ_1) and the second angle of incidence (ϕ_2) as a light ray passes through a triangular prism. If the critical angle of the prism material is 41.8° , then the minimum angle of deviation of the incident light is:

- a) 17.27°
b) 21.73°
c) 25.46°
d) 30.25°



[9] The graph shows the relationship between the angles of incidence (ϕ_1) of a light ray on one face of a triangular prism and the deviation angles (α) of this ray. Therefore, the prism apex angle and the refractive index of its material for the incident light are, respectively:

- a) 1.5, 60°
- b) 1.45, 80°
- c) 1.5, 75°
- d) 1.35, 80°



Second: Essay

[10] An equilateral triangular prism: if the minimum angle of deviation of an incident light ray is 30° , calculate:

- a) The refractive index of the prism material.
- b) The angle of incidence of the ray.
- c) The angle of emergence.

**Chapter 3| Prism****Group (A)**

[1] The apex angle of a triangular prism:

- a) Depends on both the angle of incidence of the light ray on the prism and the angle of refraction.
- b) Depends only on the angle of incidence of the light ray on the prism.
- c) Depends only on the angle of refraction of the ray inside the prism.
- d) Is constant for a given prism.

[2] A light ray is incident on one face of a triangular prism with an apex angle of 75° and refractive index ($\sqrt{2}$), and it emerges grazing the opposite face. The value of the first angle of incidence is:

- a) 0°
- b) 30°
- c) 45°
- d) 60°

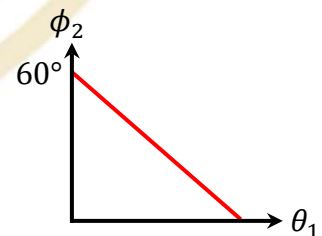
[3] An equilateral triangular prism: if the angle of minimum deviation of an incident light ray is 30° , then:

..... angle of emergence — refractive index of the prism material

- a) $30^\circ, (\sqrt{2})$
- b) $30^\circ, (\frac{\sqrt{3}}{2})$
- c) $45^\circ, (\sqrt{2})$
- d) $45^\circ, (\frac{\sqrt{3}}{2})$

[4] The graph represents the relationship between the first angle of refraction (θ_1) and the second angle of incidence (ϕ_2) as a light ray passes through a triangular prism. If the critical angle of the prism material is 41.8° , then the minimum deviation angle of the incident light is:

- a) 17.27°
- b) 21.73°
- c) 25.46°
- d) 37.18°



(5) If the minimum deviation is 30° for an equilateral triangular prism, determine the refractive index of its material and the angle of incidence and emergence of the ray in this case.

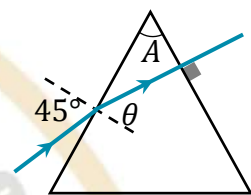
Group (B)

[1] The ratio between the first angle of refraction and the second angle of incidence in a triangular prism in the position of minimum deviation $\left(\frac{\theta_1}{\phi_2}\right)$:

- a) Greater than one.
- b) Less than one.
- c) Equal to one.
- d) Cannot be determined.

[2] In the adjacent figure, the apex angle of the prism (A) is:

- a) Greater than 45°
- b) Less than 45°
- c) Equal to 45°
- d) Equal to 60°



[3] An equilateral triangular prism: if the angle of minimum deviation of an incident light ray is 30° , then:

..... angle of emergence — refractive index of the prism material

- a) $30^\circ, (\sqrt{2})$
- b) $30^\circ, \left(\frac{\sqrt{3}}{2}\right)$
- c) $45^\circ, (\sqrt{2})$
- d) $45^\circ, \left(\frac{\sqrt{3}}{2}\right)$

[4] The factors on which the angle of deviation in any triangular prism depends are:

- a) The apex angle of the prism.
- b) The angle of incidence of the light ray.
- c) The refractive index of the prism material.
- d) All of the pervious.

(5) A light ray is incident normally on one face of a glass triangular prism and emerges grazing the opposite face. If the prism apex angle is 45° , determine the refractive index of the prism glass and the speed of light in the prism.

Group (C)

[1] When increasing the wavelength of light incident on a triangular prism at minimum deviation, the minimum deviation angle:

- a) Increases.
- b) Decreases.
- c) Does not change.
- d) Increases up to a limit.

[2] A light ray is incident on an equilateral triangular prism with refractive index ($\sqrt{2}$) and emerges grazing the opposite face. The value of the first angle of incidence is:

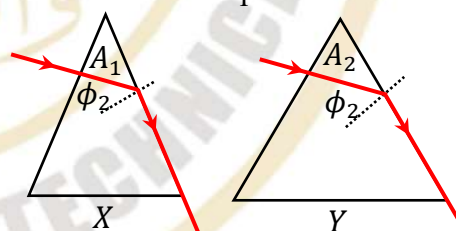
- a) 21.5°
- b) 30°
- c) 36.7°
- d) 60°

[3] The ratio of the angle of incidence to the angle of emergence for a light ray incident on a triangular prism at minimum deviation is:

- a) Greater than 1
- b) Less than 1
- c) Equal to 1
- d) Equal to zero

[4] The figure shows two prisms X and Y made of different types of glass. If the apex angle of prism X is less than that of prism Y, and in both cases a light ray is incident normally on one face and emerges grazing the other face, then the refractive index of prism X is the refractive index of prism Y:

- a) Greater than
- b) Less than
- c) Equal to
- d) Half

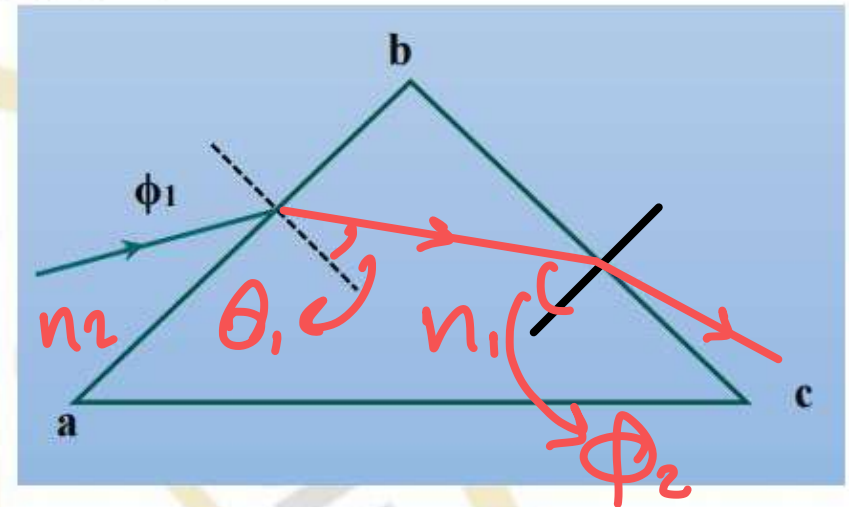


(5) A prism has an apex angle of 60° . A light ray is incident on one face at an angle of 45° . If the refractive index of the prism material is ($\sqrt{2}$), determine the angle of emergence and the angle of deviation.

First: MCQ

[1] A triangular prism with refractive index (n_1) is placed in a liquid with refractive index (n_2), where ($n_1 < n_2$). The ray refracts to strike face BC and will:

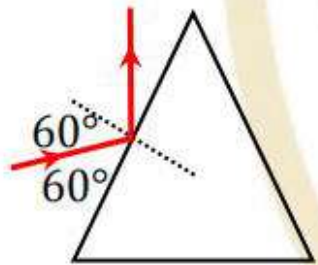
- a) Undergo total internal reflection.
- b) Refract parallel to the separating surface.
- c) Refract toward the base.
- d) Refract away from the base.



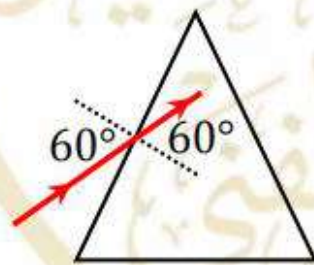
$$n \propto \frac{1}{\theta}$$

[2] A student drew the incident and refracted rays as shown in the figure, but the drawing was incorrect. For the path of the refracted ray to be correct, the figure should be modified to look like figure

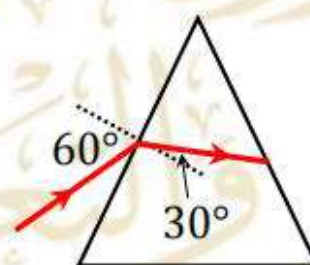
(The refractive index of the prism material is ($n = \sqrt{3}$)).



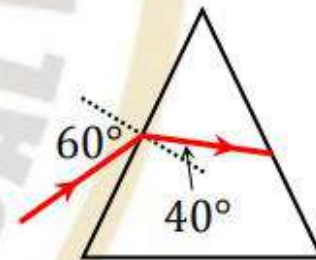
~~a)~~



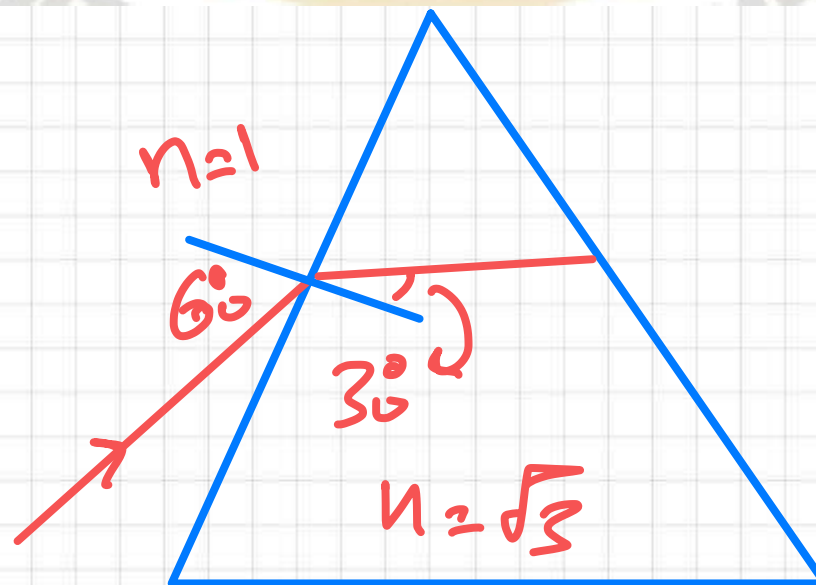
~~b)~~



c)



~~d)~~



$$\frac{n_2}{n_1} = \frac{\sin \theta_1}{\sin \theta_2}$$

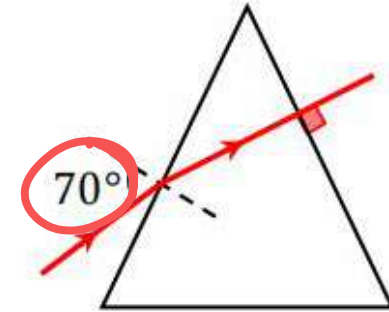
$\downarrow$

$$\frac{\sqrt{3}}{1} = \frac{\sin 60}{\sin \theta_2}$$

$\rightarrow 30$

[3] The figure shows the path of a light ray incident on one face of a triangular prism with an apex angle of 38° . The ray emerges from the opposite face along its original direction. The angle of deviation of the light ray in the prism is:

- a) 30°
- b) 32°
- c) 38°
- d) 70°



$$A = \theta_1 + \phi_2$$

$$\alpha = \phi_1 + \theta_2 - A$$

$$n = \frac{\sin \phi_1}{\sin \theta_1} = \frac{\sin \theta_2}{\sin \phi_2}$$

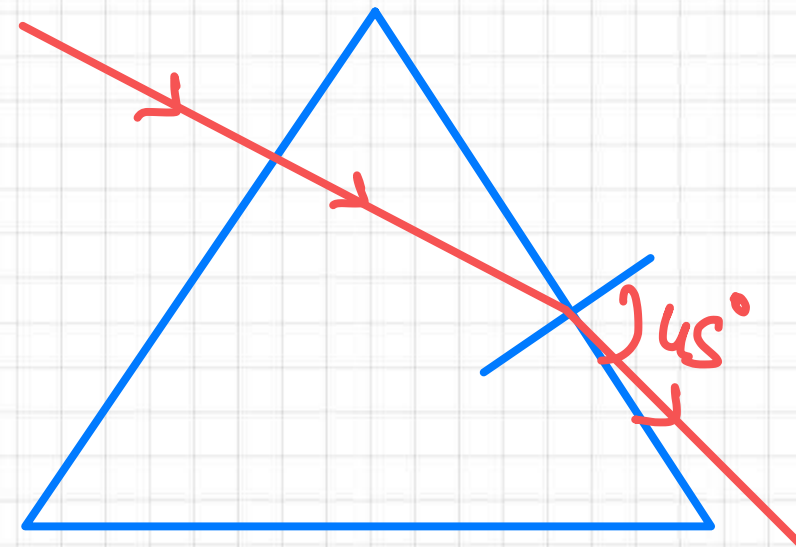
[4] A light ray is incident normally on one face of a triangular prism with an apex angle of 30° . If the refractive index of the prism material is $(\sqrt{2})$, then the angle of emergence from the prism equals:

a) 0° b) 30° c) 45° d) 60°

$$A = \theta_1 + \phi_2$$

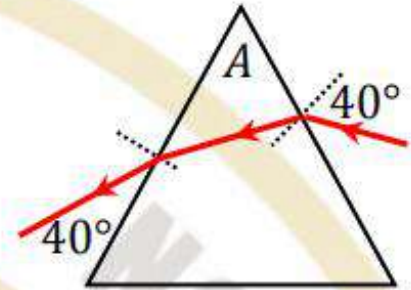
$$\alpha = \phi_1 + \theta_2 - A$$

$$\sqrt{2} = \frac{\sin \phi_1}{\sin \theta_1} = \frac{\sin \theta_2}{\sin \phi_2} \rightarrow 45$$



[5] A light ray is incident on one face of an equilateral triangular prism at an angle of 40° , and it emerges from the opposite face as shown in the figure. Therefore, the angle of deviation of the ray is equal to:

- a) 30°
- b) 40°
- c) 50°
- d) 60°



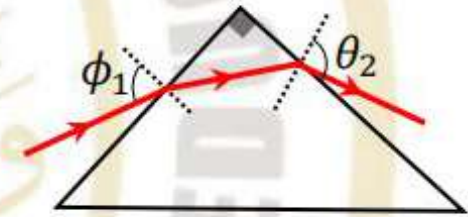
$$A = \theta_1 + \phi_2$$

$$\alpha = \phi_1 + \theta_2 - A$$

$$n = \frac{\sin \phi_1}{\sin \theta_1} = \frac{\sin \theta_2}{\sin \phi_2}$$

[6] The figure shows a light ray incident at an angle (ϕ_1) on a triangular prism in the position of minimum deviation. If the refractive index of the prism material is 1.366, then the angle of emergence and the minimum angle of deviation, respectively, are:

- a) $45^\circ, 60^\circ$
- b) $45^\circ, 75^\circ$
- c) $60^\circ, 60^\circ$
- d) $60^\circ, 75^\circ$



$$45 \quad \theta_0 = \frac{A}{2} \rightarrow 90$$

$$60 \leftarrow \phi_0 = \frac{\alpha_0 + A}{2} \rightarrow 90$$

$$75 \leftarrow$$

$$1.366 \quad n = \frac{\sin \phi_0 \rightarrow}{\sin \theta_0 \quad 45}$$

[7] When light is dispersed into its components by a triangular prism, violet light undergoes greater deviation than red light because:

- ~~a) $n_{\text{(red)}} > n_{\text{(violet)}}$~~
- b) $\lambda_{\text{(red)}} > \lambda_{\text{(violet)}}$
- ~~c) $v_{\text{(red)}} > v_{\text{(violet)}}$~~
- ~~d) $T_{\text{(red)}} < T_{\text{(violet)}}$~~

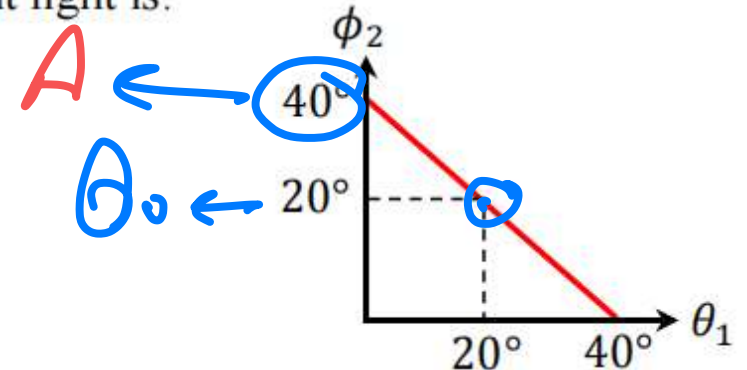
$$\alpha \propto \frac{1}{\lambda}$$

$$n \propto \rho \propto \alpha \propto \frac{1}{v} \propto \frac{1}{\lambda} \propto \frac{1}{\theta} \propto \frac{1}{\phi_c}$$

[8] The adjacent graph represents the relationship between the first angle of refraction (θ_1) and the second angle of incidence (ϕ_2) as a light ray passes through a triangular prism. If the critical angle of the prism material is 41.8° , then the minimum angle of deviation of the incident light is:

- a) 17.27°
- b) 21.73°
- c) 25.46°
- d) 30.25°

$$\theta_0 = \frac{A}{2} \rightarrow 40$$



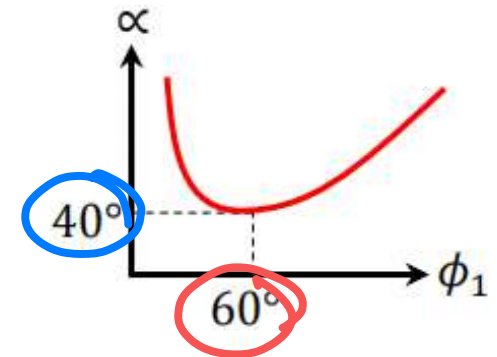
$$\sin \phi_c = \frac{1}{n} \rightarrow 1.5$$

$$\theta_0 = \frac{A}{2} \rightarrow 40$$

$$30.86 \leftarrow \phi_0 = \frac{\alpha_0 + A}{2}$$

$$1.5 \leftarrow n = \frac{\sin \phi_0}{\sin \theta_0} \rightarrow 20$$

[9] The graph shows the relationship between the angles of incidence (ϕ_1) of a light ray on one face of a triangular prism and the deviation angles (α) of this ray. Therefore, the prism apex angle and the refractive index of its material for the incident light are, respectively:



$$40^\circ \theta_0 = \frac{A}{2} 80^\circ$$

$$60^\circ \leftarrow \phi_0 = \frac{\overset{40^\circ}{\alpha_0} + A \rightarrow 80^\circ}{2}$$

$$1.347 \quad n = \frac{\sin \phi_0 \quad 60^\circ}{\sin \theta_0 \quad 40^\circ}$$

[10] An equilateral triangular prism: if the minimum angle of deviation of an incident light ray is 30° , calculate:

- a) The refractive index of the prism material. $\sqrt{2}$
 - b) The angle of incidence of the ray. 45
 - c) The angle of emergence. 45
- $A = 60$
 $\alpha_0 = 30$

$$30 \leftarrow \theta_0 = \frac{A}{2} \rightarrow 60$$

$$45 \leftarrow \phi_0 = \frac{\alpha_0 + A}{2} \rightarrow 60$$

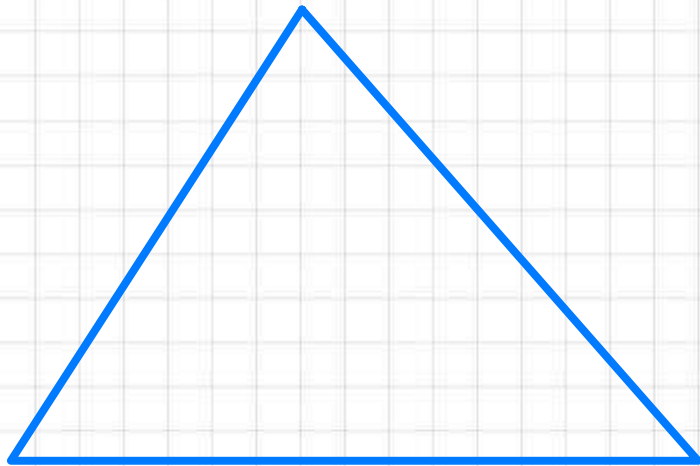
$$\sqrt{2} \leftarrow n = \frac{\sin \phi_0}{\sin \theta_0} \rightarrow 45$$

$\rightarrow 30$

Group (A)

[1] The apex angle of a triangular prism:

- ~~a)~~ Depends on both the angle of incidence of the light ray on the prism and the angle of refraction.
- ~~b)~~ Depends only on the angle of incidence of the light ray on the prism.
- ~~c)~~ Depends only on the angle of refraction of the ray inside the prism.
- d) Is constant for a given prism.



$$A = \theta_1 + \theta_2$$

$$\alpha = \theta_1 + \theta_2 - A$$

$$n = \frac{\sin \theta_1}{\sin \theta_2} = \frac{\sin \theta_1}{\sin \theta_2}$$

[2] A light ray is incident on one face of a triangular prism with an apex angle of 75° and refractive index ($\sqrt{2}$), and it emerges grazing the opposite face. The value of the first angle of incidence is:

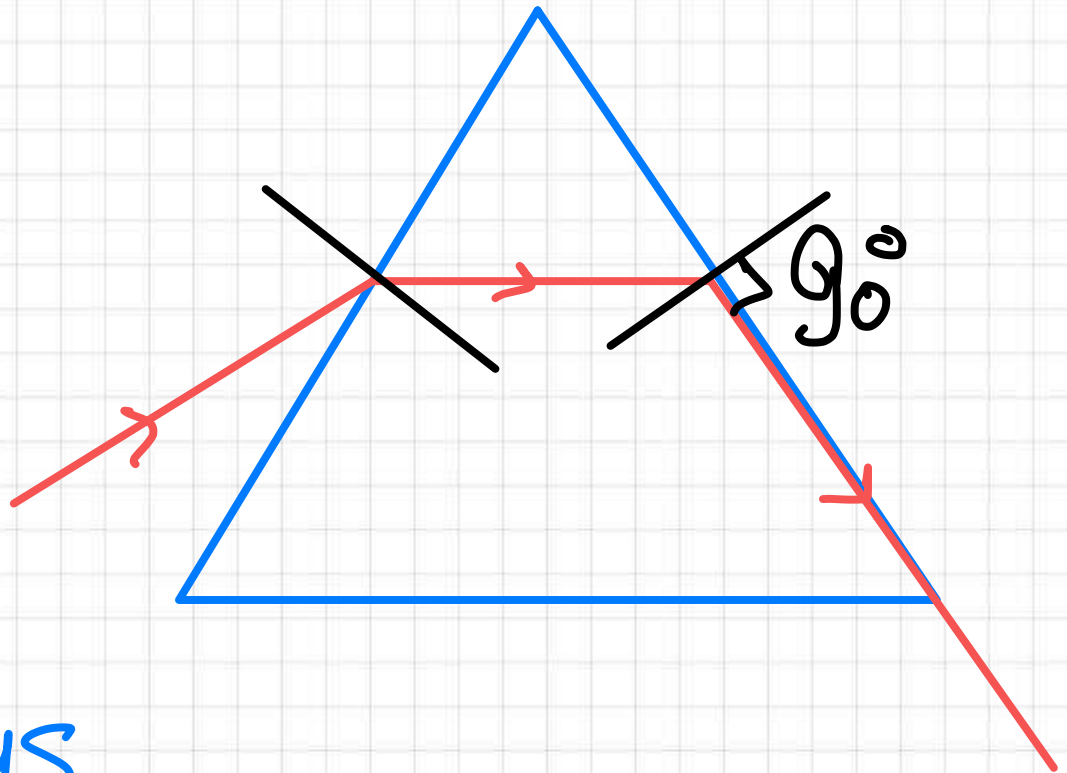
- a) 0°
- b) 30°
- c) 45°
- d) 60°

$$\theta_2 = 90^\circ \quad A = 75^\circ \quad n = \sqrt{2}$$

$$A = \theta_1 + \theta_2 \quad 75^\circ = \theta_1 + 90^\circ$$

$$\alpha = \theta_1 + \theta_2 - A$$

$$n = \frac{\sin \theta_1}{\sin \theta_2} = \frac{\sin \theta_1}{\sin 90^\circ}$$



[3] An equilateral triangular prism: if the angle of minimum deviation of an incident light ray is 30° , then:

..... angle of emergence — refractive index of the prism material

~~a) $30^\circ, (\sqrt{2})$~~

~~b) $30^\circ, (\frac{\sqrt{3}}{2})$~~

c) $45^\circ, (\sqrt{2})$

~~d) $45^\circ, (\frac{\sqrt{3}}{2})$~~

$$A = 60$$

$$\alpha_0 = 30$$

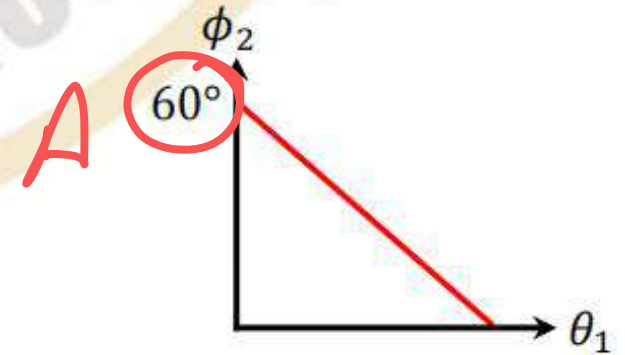
$$30 \quad \theta_0 = \frac{A \rightarrow 60}{2}$$

$$45 \leftarrow \theta_0 = \frac{\alpha_0 \rightarrow 30 + A \rightarrow 60}{2}$$

$$\sqrt{2} \leftarrow n = \frac{\sin \theta_0 \rightarrow 45}{\sin \theta_0 \rightarrow 30}$$

[4] The graph represents the relationship between the first angle of refraction (θ_1) and the second angle of incidence (ϕ_2) as a light ray passes through a triangular prism. If the critical angle of the prism material is 41.8° , then the minimum deviation angle of the incident light is:

- a) 17.27°
- b) 21.73°
- c) 25.46°
- d) 37.18°



$$A = \phi_2 + \theta_1$$

$$60 = 60 + 0$$

$$\sin 41.8 = \frac{1}{n} \rightarrow 1.5$$

$$30 \leftarrow \theta_0 = \frac{A 60}{2}$$

$$48.6 \leftarrow \phi_0 = \frac{\alpha_0 + A 60}{2}$$

$$1.5 = \frac{\sin \phi_0 \rightarrow 48.6}{\sin \theta_0 \rightarrow 30}$$

(5) If the minimum deviation is 30° for an equilateral triangular prism, determine the refractive index of its material and the angle of incidence and emergence of the ray in this case.

$$A = 60 \quad \alpha_0 = 30$$

$$30 \leftarrow \theta_0 = \frac{A}{2} 60$$

$$45 \leftarrow \phi_0 = \frac{\alpha_0 + A}{2} 60$$

$$\sqrt{2} \quad n = \frac{\sin \phi_0}{\sin \theta_0} \quad 45 \rightarrow 30$$

Group (B)

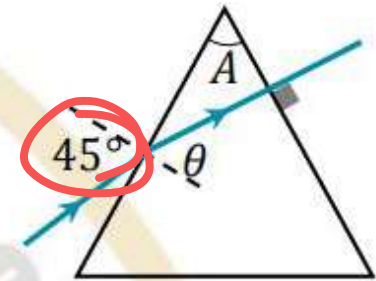
[1] The ratio between the first angle of refraction and the second angle of incidence in a triangular prism in the position of minimum deviation $\left(\frac{\theta_1}{\phi_2}\right)$

- a) Greater than one.
- b) Less than one.
- c) Equal to one.
- d) Cannot be determined.

$$\theta_0 = \theta_1 = \phi_2$$

[2] In the adjacent figure, the apex angle of the prism (A) is:

- a) Greater than 45°
- b) Less than 45°
- c) Equal to 45°
- d) Equal to 60°



$$A = \theta_1 + \theta_2 \rightarrow 0$$

$$n \uparrow$$

$$\theta \downarrow$$

$$n = \frac{\sin \phi_1}{\sin \theta_1} \rightarrow 45$$

[3] An equilateral triangular prism: if the angle of minimum deviation of an incident light ray is 30° , then:

..... angle of emergence — refractive index of the prism material

a) $30^\circ, (\sqrt{2})$

b) $30^\circ, (\frac{\sqrt{3}}{2})$

c) $45^\circ, (\sqrt{2})$

d) $45^\circ, (\frac{\sqrt{3}}{2})$

$$A = 60$$

$$\alpha_0 = 30$$

$$30 \theta_0 = \frac{A 60}{2}$$

$$45 \theta_0 = \frac{30 \alpha_0 + A 60}{2}$$

$$\sqrt{2} n = \frac{\sin \theta_0 45}{\sin \theta_0 30}$$

[4] The factors on which the angle of deviation in any triangular prism depends are:

- ~~a)~~ The apex angle of the prism.
- ~~b)~~ The angle of incidence of the light ray.
- ~~c)~~ The refractive index of the prism material.
- d) All of the pervious.

$$\alpha = \theta_1 + \theta_2 - A$$

$$n = \frac{\sin \theta_1}{\sin \theta_2} = \frac{\sin \theta_2}{\sin \theta_1}$$

(5) A light ray is incident normally on one face of a glass triangular prism and emerges grazing the opposite face. If the prism apex angle is 45° , determine the refractive index of the prism glass and the speed of light in the prism.

$$V_g = \frac{c}{\sqrt{2}}$$

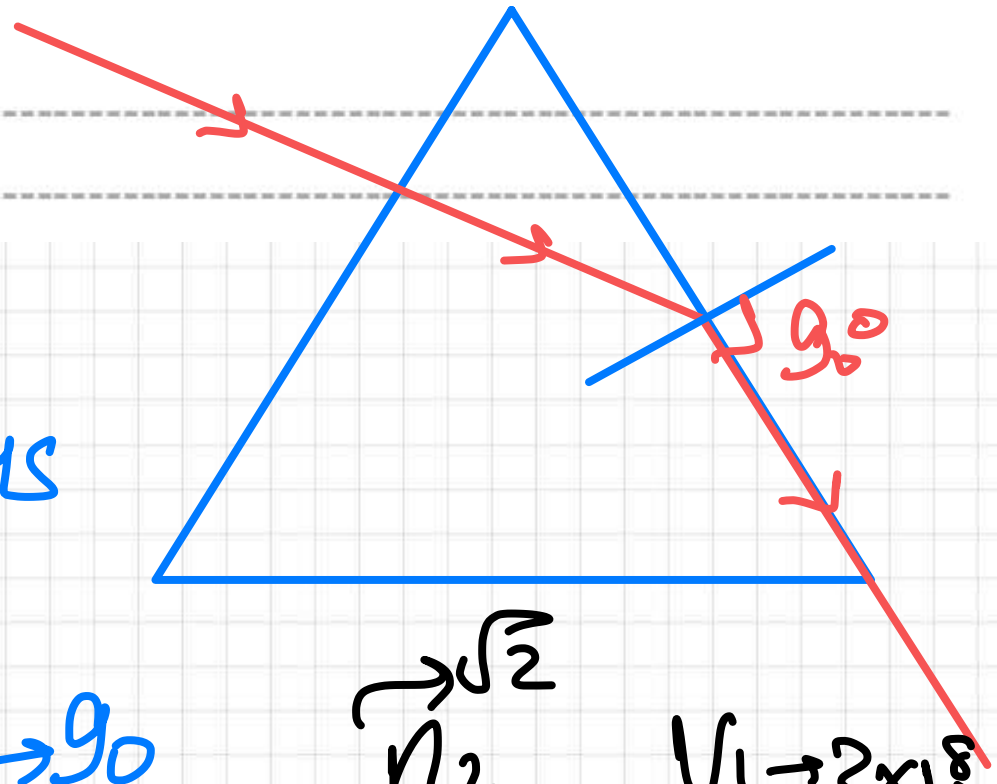
$$45^\circ$$

$$A = \theta_1 + \theta_2$$

$$45^\circ \uparrow \alpha = \theta_1 + \theta_2 - A \rightarrow 90^\circ$$

$$\frac{\sin \theta_1}{\sin \theta_2} = \frac{\sin \theta_2}{\sin \theta_1}$$

$$n = \sqrt{2}$$



$$\frac{n_2}{n_1} = \frac{V_1 \rightarrow 3 \times 10^8}{V_2 \rightarrow 2.1 \times 10^8 \text{ m/s}}$$

Group (C)

[1] When increasing the wavelength of light incident on a triangular prism at minimum deviation, the minimum deviation angle:

- a) Increases.
- b) Decreases.
- c) Does not change.
- d) Increases up to a limit.

$$n \propto \frac{1}{\lambda} \propto \alpha \propto \alpha_0$$

$$P \propto n \propto \alpha \propto \alpha_0 \propto \frac{1}{\lambda} \propto \frac{1}{\theta} \propto \frac{1}{\lambda} \propto \frac{1}{\phi_c}$$

$$\textcircled{n} = \frac{\sin \phi_0}{\sin \theta_0} = \frac{\sin \left[\frac{\alpha_0 + \textcircled{A}}{2} \right]}{\sin \left[\frac{\textcircled{A}}{2} \right]}$$

[2] A light ray is incident on an equilateral triangular prism with refractive index $\sqrt{2}$ and emerges grazing the opposite face. The value of the first angle of incidence is:

- a) 21.5°
- b) 30°
- c) 36.7°
- d) 60°

$$A = \theta_1 + \theta_2$$

60 15 45

$$A = 60$$

$$n = \sqrt{2}$$

$$\theta_2 = 90$$

$$\alpha = \theta_1 + \theta_2 - A$$

21.47 90 60

$$n = \frac{\sin \theta_1}{\sin \theta_2} = \frac{\sin \theta_1}{\sin 90}$$

21.47 90 45

$$\sqrt{2} = \frac{\sin \theta_1}{1}$$

[3] The ratio of the angle of incidence to the angle of emergence for a light ray incident on a triangular prism at minimum deviation is:

- a) Greater than 1
- b) Less than 1
- c) Equal to 1
- d) Equal to zero

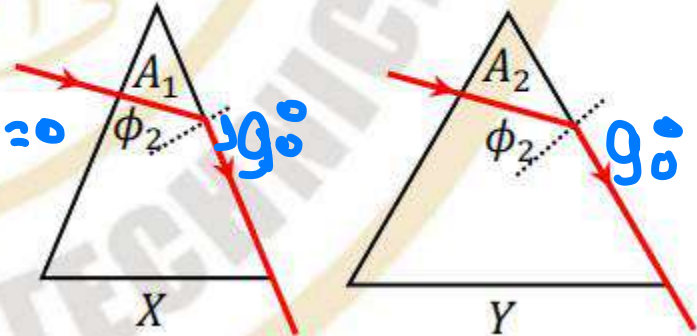
$$i_1 = i_2 = i_0$$

[4] The figure shows two prisms X and Y made of different types of glass. If the apex angle of prism X is less than that of prism Y, and in both cases a light ray is incident normally on one face and emerges grazing the other face, then the refractive index of prism X is the refractive index of prism Y:

- a) Greater than
- b) Less than
- c) Equal to
- d) Half

$$A_x < A_y$$

$$\theta_1 = \phi_1 = 0^\circ$$



$$A = \phi_2 = \phi_c$$

$$n \propto \frac{1}{\phi_c} \propto \frac{1}{A}$$

$$\sin \phi_c = \frac{1}{n}$$

$$A = \theta_1 + \phi_2$$

$$\alpha = \phi_1 + \theta_2 - A$$

$$n = \frac{\sin \phi_1}{\sin \theta_1} = \frac{\sin \theta_2}{\sin \phi_2}$$

(5) A prism has an apex angle of 60° . A light ray is incident on one face at an angle of 45° . If the refractive index of the prism material is $\sqrt{2}$, determine the angle of emergence and the angle of deviation.

$$\phi_0 = \frac{\alpha_0 + A}{2} \rightarrow 60$$

$\nearrow 30$
 $\nwarrow 45$

$$\phi_0 = \theta_2 = 45$$

$$\alpha_0 = 30^\circ$$

$$A = 60$$

$$\phi_0 = 45$$

$$n = \sqrt{2}$$

$$\phi_0 = 45$$

$$\alpha_0 =$$

$$\theta_0 = 30$$



Chapter 4| Laws of circular motion

First: Multiple Choice Questions

(1) A body moves eastward with a velocity of 2 m/s. A resultant force acts on it toward the south, so the body

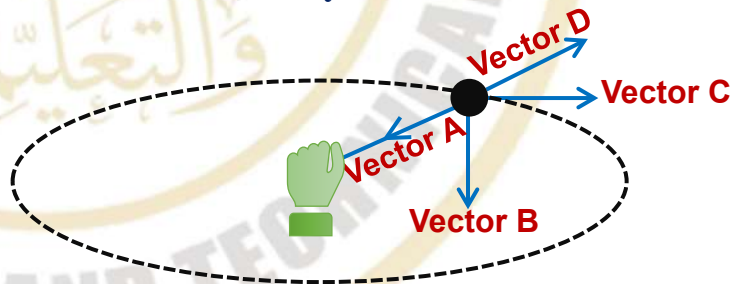
- A) Its speed increases
- B) Moves in a circular path
- C) Its direction remains constant
- D) Its acceleration is zero

2. Centripetal acceleration results from

- A) Change in the magnitude of velocity
- B) Change in the direction of velocity
- C) Change in both magnitude and direction of velocity
- D) Change in the applied force

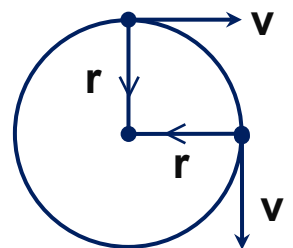
3- which vectors represent the velocity and acceleration of a body in circular motion?

- A) Velocity $\rightarrow$ A , Acceleration $\rightarrow$ B
- B) Velocity $\rightarrow$ B , Acceleration $\rightarrow$ D
- C) Velocity $\rightarrow$ D , Acceleration $\rightarrow$ C
- D) Velocity $\rightarrow$ C , Acceleration $\rightarrow$ A



4. The acceleration of a body in uniform circular motion is due to

- A) Change in direction of velocity
- B) Change in magnitude of velocity
- C) Both magnitude and direction remain constant
- D) Change in both magnitude and direction

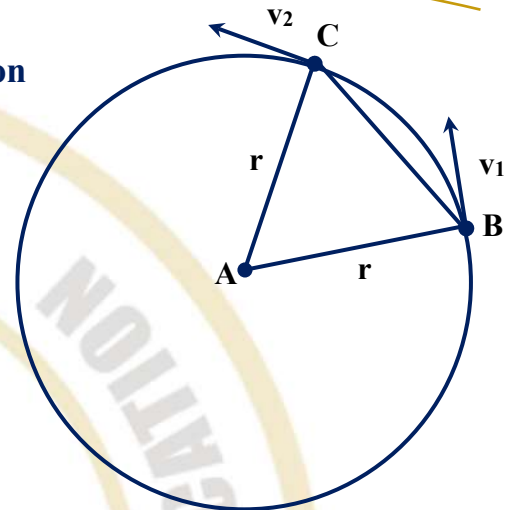


5. When a body moves in a circular path, the direction of the centripetal force is

- A) In the same direction as the velocity
- B) In the same direction as the acceleration
- C) Opposite to the direction of the acceleration
- D) Opposite to the direction of the velocity

6. The figure shows a body moving in uniform circular motion from point B to point C during a time interval t . Which of the following statements is correct?

- A) The direction of acceleration is the same as the direction of velocity v_1
- B) The magnitude of acceleration is inversely proportional to the distance AB
- C) The magnitude of acceleration is directly proportional to the distance AB
- D) The direction of acceleration is the same as the direction of velocity v_2



7. Two bodies (A) and (B) move in two different circular paths with the same centripetal acceleration.

If the speed of body (A) is greater than the speed of body (B), then:

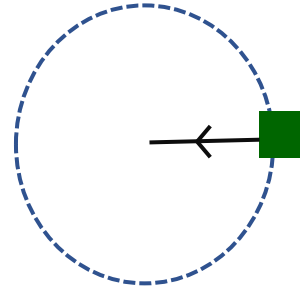
- A) The radius of the path of body (A) is smaller than that of body (B)
- B) The radius of the path of body (A) is equal to that of body (B)
- C) The centripetal force acting on body (B) is greater than that acting on body (A)
- D) The radius of the path of body (A) is greater than that of body (B)

8. A body moves with a uniform speed (v) in a circular path, and its centripetal acceleration is (a). If another identical body moves in the same circular path with a uniform speed ($3v$), the centripetal acceleration becomes:

- A) $3a$
- B) $6a$
- C) a
- D) $9a$

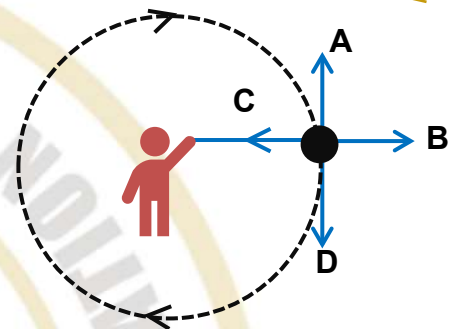
9. Someone ties a body to a string and holds the other end, rotating the body in a circular path. Suddenly, the string breaks. The direction of motion of the body after the string breaks will be

- A) In a circular path but with a larger radius
- B) Toward the center along the radius
- C) Along the tangent at the moment of breaking
- D) Along the extension of the radius outward



10. A child rotates a small stone using a string as shown in the figure. When the string is suddenly released, the body moves in.....

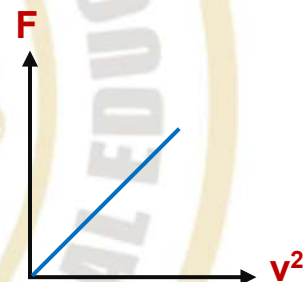
- A) Direction A
- B) Direction B
- C) Direction C
- D) Direction D



11. The graph represents the relation between the centripetal force and the square of the tangential velocity.

The slope of the graph equals:

- A) $r \cdot m^2$
- B) $r \cdot m$
- C) m/r
- D) r/m



12. A body of mass 3 kg moves in a circular path of radius 10 m with a time period of π s. The magnitude of the centripetal force is

- A) 15 N
- B) 30 N
- C) 60 N
- D) 120 N



13. A man drives his car whose weight is $5 \times 10^4 \text{ N}$ in a circular path of radius 500 m with a tangential speed of 7.5 m/s.

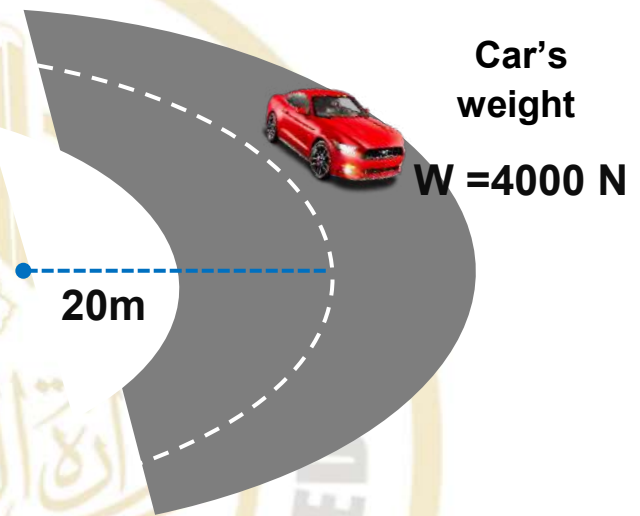
If the frictional force is 571.5 N and $g = 10 \text{ m/s}^2$, then the mass of the man is ..

- A) 40 kg
- B) 58 kg
- C) 80 kg
- D) 800 kg

14. The car shown in the figure moves in a circular path.

If the speed of the car is doubled while keeping the centripetal force constant, the car needs a path whose radius is the radius of the first path.

- A) Double
- B) One quarter
- C) Four times
- D) Half



15. A car of mass 1000 kg moves in a circular field of radius 20 m.

If the maximum frictional force that the car tires can provide is 450 N, the maximum speed the driver must not exceed so that the car remains in the circular path is

- A) 3 m/s
- B) 30 m/s
- C) 15 m/s
- D) 10 m/s



Second: Essay Questions

1) On rotating a stone attached to the end of a string in a circular path.
What is the direction of the force affecting on the stone? What is its benefit?
What is the direction of motion if the string is cut?

.....
.....

2- A car of mass 1000 kg is moving at a constant speed of 5 m/s in a curve of radius 50 m.
Calculate centripetal friction force that keeps the car moving around the curve.

.....
.....
.....
.....

3- A car of mass 750 kg moves in a circle of diameter 80 m. If the centripetal force acting on the car is 7500 N, find the speed of the car.

.....
.....
.....
.....

4- An object of mass 0.01 Kg moves in a circular path of radius 150 cm if it takes 3 s to make a complete revolution , calculate magnitude & direction of the centripetal force.

.....
.....
.....
.....

**Chapter 4| Laws of circular motion****Group (A)****First: Multiple Choice Questions**

1-When a resultant force acts on a body moving with constant velocity in a direction opposite to its motion, the body's velocity

- A) **Increases in magnitude and direction remains constant**
- B) **Decreases in magnitude and direction changes**
- C) **Decreases in magnitude and direction remains constant**
- D) **Increases in magnitude and direction changes**

2.When a body moves in uniform circular motion, its velocity

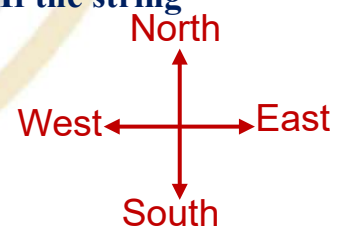
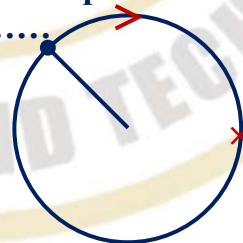
- A) **Changes in magnitude and direction**
- B) **Changes in magnitude and remains constant in direction**
- C) **Remains constant in magnitude but changes in direction**
- D) **Remains constant in both magnitude and direction**

3.The angle between the centripetal acceleration and the instantaneous (tangential) velocity is

- A) **0°**
- B) **45°**
- C) **90°**
- D) **180°**

4. A ball tied to a string move in a horizontal circular path clockwise. If the string breaks at point (X), the ball moves

- A) **In a circular direction**
- B) **Toward the west**
- C) **Toward the east (along the tangent)**
- D) **Toward the south**

**Second: Essay Questions**

5- An object of 2 kg mass is tied to the end of a string to rotate in a horizontal circular path with a radius of 1.5 m making 3 revolutions in 9 s. Calculate:

- (a) The linear (tangential) speed. (b) The tension force of the string on the body.

First: Multiple Choice Questions

1. When a body moves in uniform circular motion, the physical quantities remain constant except

- A) The weight of the body
- B) The velocity vector
- C) The mass of the body
- D) The uniform speed

2. The centripetal acceleration of a body moving in a circular path increases when

- A) The radius of the circular path increases
- B) The mass of the body decreases
- C) The radius of the circular path decreases
- D) The mass of the body increases

3. A body of mass 5 kg moves in a circular path of radius 0.1 m and takes a time equal to π s to complete one revolution.

The centripetal force acting on the body equals N

- A) 2
- B) 6
- C) 4
- D) 8

4. From the given figure, the Earth moves in its orbit around the Sun due to:

- A) An attractive force in the same direction as the planets
- B) An attractive force opposite to the direction of the Sun
- C) An attractive force in the same direction as the Earth's motion
- D) An attractive force perpendicular to the direction of the Earth's motion



Second: Essay Questions

5- A helicopter toy of mass 100 g flies in a circular path of radius 1 m and rotates at a rate of 100 revolutions in 20 sec. Calculate:

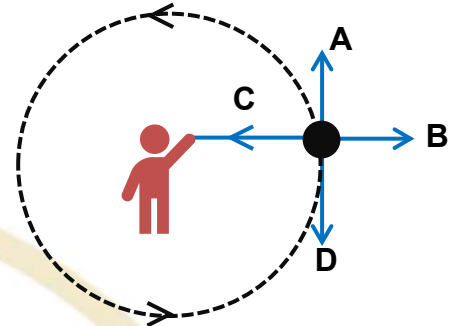
- a) The linear (tangential) velocity of the toy.
- b) The centripetal acceleration.

c) The centripetal force.

First: Multiple Choice Questions

1. A child rotates a small stone using a string as shown in the figure. When the string is suddenly released, the body moves in.....

- A) Direction A
- B) Direction B
- C) Direction C
- D) Direction D



2. A body moves in a circular path and then moves along the tangent. The value of the force acting on it

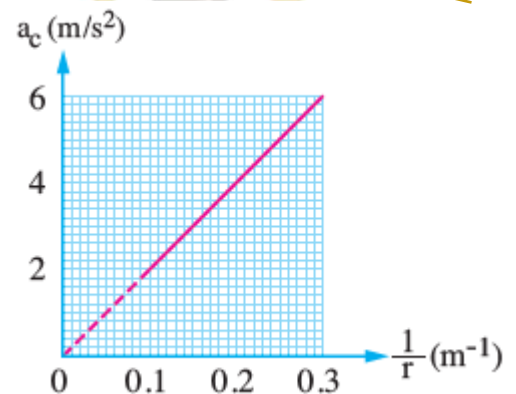
- A) Becomes zero
- B) Doubles
- C) Decreases to half
- D) Does not change

3. A body of mass 2 kg moves in a circular path of radius 5 m with a tangential speed of 2 m/s. The magnitude of the centripetal force is

- A) 0.2 N
- B) 0.4 N
- C) 1.6 N
- D) 3.2 N

4. The opposite graph shows the relationship between the centripetal acceleration (a_c) with which a body moves in a horizontal circular path and the inverse of the radius of this path ($1/r$), then the tangential velocity with which the body moves equals

- a) 4.47 m/s
- b) 5.58 m/s
- c) 3.13 m/s
- d) 9.8 m/s



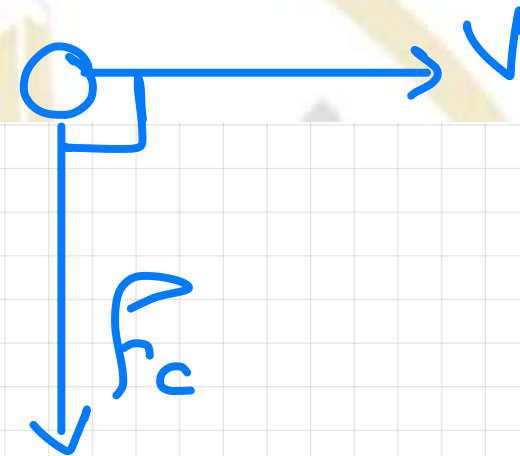
Second: Essay Questions

5) A car in amusement park of mass 200 kg moves in a circular path with velocity 10 m/s. If the centripetal force acting on it 2000 N
Find: a) Radius of rotation. b) Centripetal acceleration.

First: Multiple Choice Questions

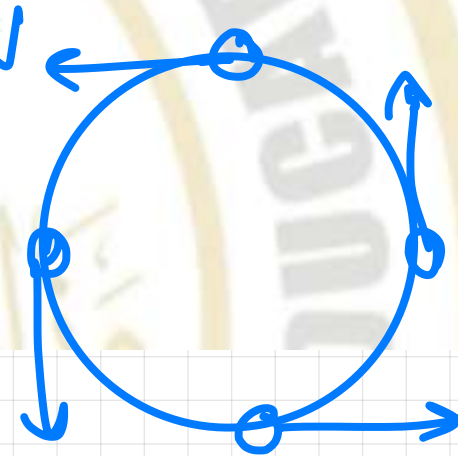
(1) A body moves eastward with a velocity of 2 m/s. A resultant force acts on it toward the south, so the body

- ~~A) Its speed increases~~
- B) Moves in a circular path
- ~~C) Its direction remains constant~~
- ~~D) Its acceleration is zero~~



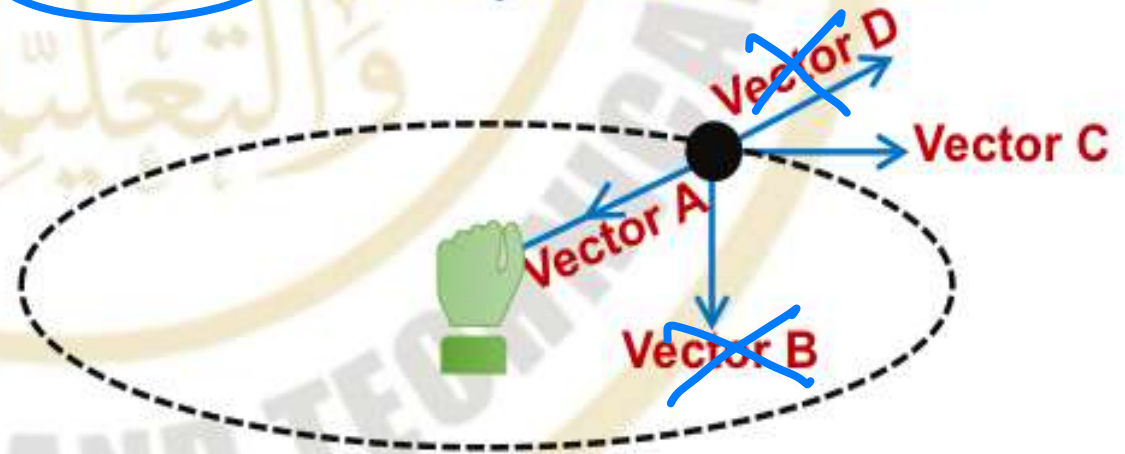
2. Centripetal acceleration results from

- ☒ A) Change in the magnitude of velocity
- ☒ B) Change in the direction of velocity
- ☒ C) Change in both magnitude and direction of velocity
- ☒ D) Change in the applied force



3-which vectors represent the velocity and acceleration of a body in circular motion?

- ~~A) Velocity $\rightarrow$ A , Acceleration $\rightarrow$ B~~
- ~~B) Velocity $\rightarrow$ B , Acceleration $\rightarrow$ D~~
- ~~C) Velocity $\rightarrow$ D , Acceleration $\rightarrow$ C~~
- D) Velocity $\rightarrow$ C , Acceleration $\rightarrow$ A**



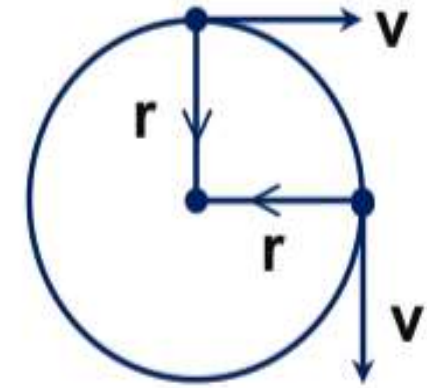
4. The acceleration of a body in uniform circular motion is due to

☒ A) Change in direction of velocity

☐ B) Change in magnitude of velocity

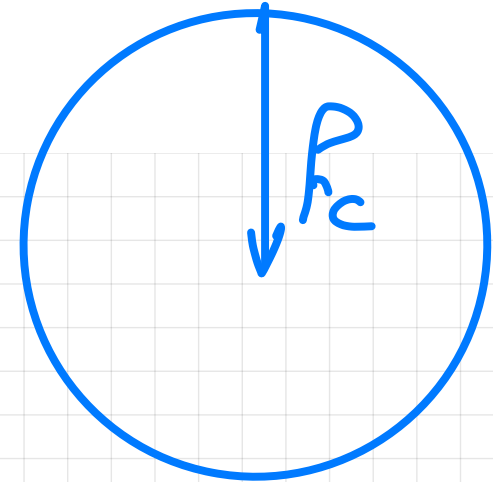
☐ C) Both magnitude and direction remain constant

☐ D) Change in both magnitude and direction



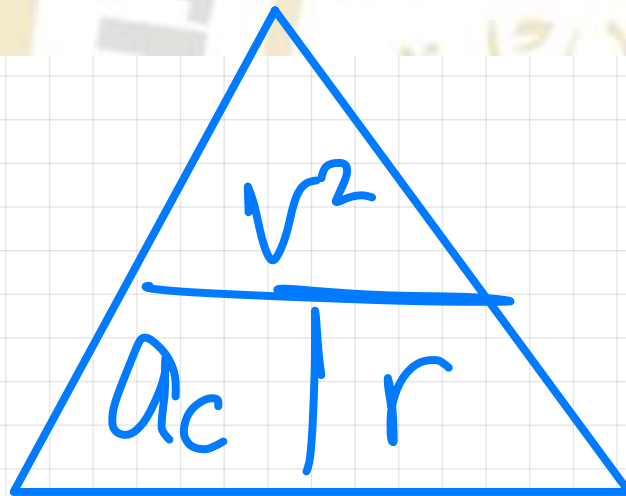
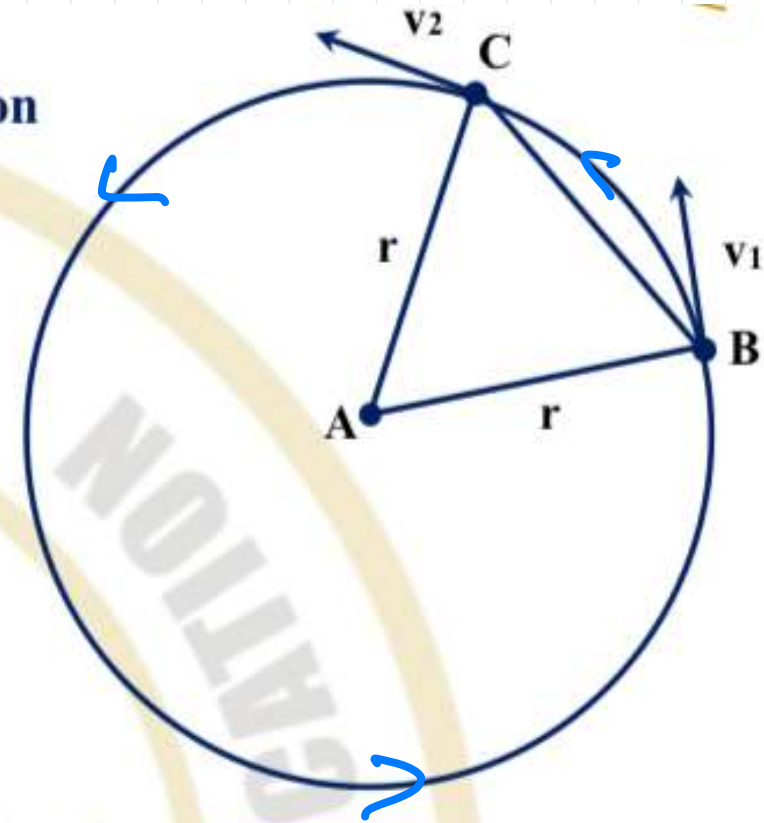
5. When a body moves in a circular path, the direction of the centripetal force is

- ~~A) In the same direction as the velocity~~
- B) In the same direction as the acceleration
- ~~C) Opposite to the direction of the acceleration~~
- ~~D) Opposite to the direction of the velocity~~



6-The figure shows a body moving in uniform circular motion from point B to point C during a time interval t . Which of the following statements is correct?

- ☒ A) The direction of acceleration is the same as the direction of velocity v_1
- ☒ B) The magnitude of acceleration is inversely proportional to the distance AB
- ☒ C) The magnitude of acceleration is directly proportional to the distance AB
- ☒ D) The direction of acceleration is the same as the direction of velocity v_2



a_c

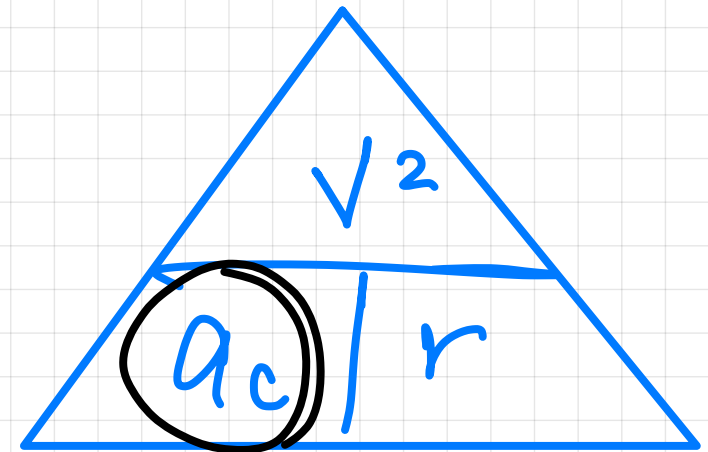
7. Two bodies (A) and (B) move in two different circular paths with the same centripetal acceleration.

If the speed of body (A) is greater than the speed of body (B), then:

- ~~a) The radius of the path of body (A) is smaller than that of body (B)~~
- ~~b) The radius of the path of body (A) is equal to that of body (B)~~
- ~~c) The centripetal force acting on body (B) is greater than that acting on body (A)~~
- d) The radius of the path of body (A) is greater than that of body (B)

$$\frac{V_A^2}{V_B^2} = \frac{r_A}{r_B}$$

m	v^2
F_c	r



8. A body moves with a uniform speed (v) in a circular path, and its centripetal acceleration is (a). If another identical body moves in the same circular path with a uniform speed ($3v$) the centripetal acceleration becomes:

A) $3a$

B) $6a$

C) a

D) $9a$

m
 r

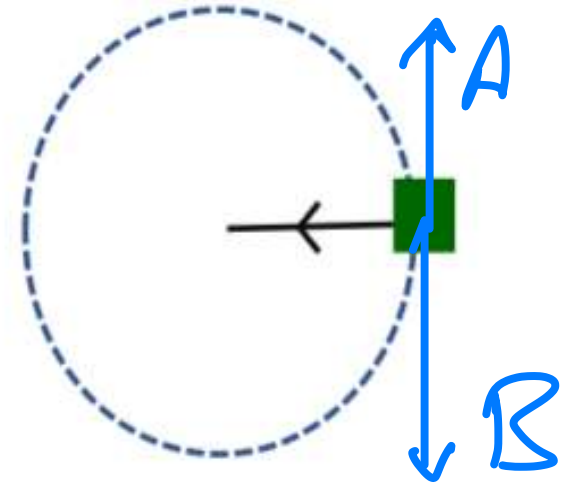
$$a_c = \frac{v^2}{r}$$

$$\frac{a_{c1}}{a_{c2}} = \frac{v_1^2 \rightarrow 1}{v_2^2 \rightarrow 9}$$

$$a_{c2} = 9a_{c1}$$

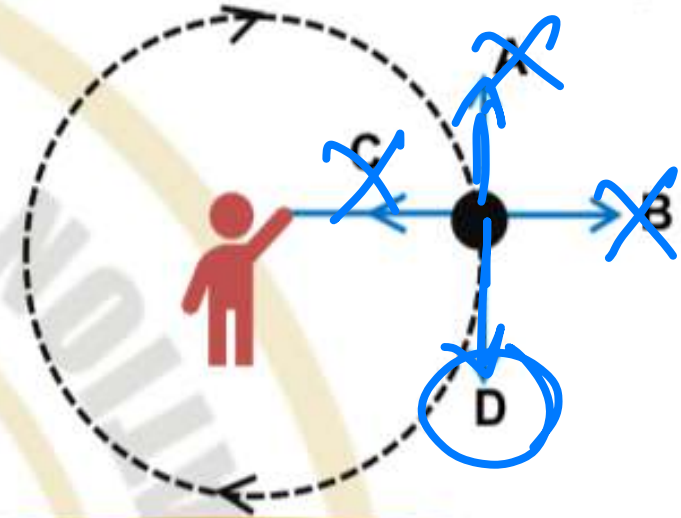
9. Someone ties a body to a string and holds the other end, rotating the body in a circular path. Suddenly, the string breaks. The direction of motion of the body after the string breaks will be

- ~~a) In a circular path but with a larger radius~~
- ~~b) Toward the center along the radius~~
- c) Along the tangent at the moment of breaking
- ~~d) Along the extension of the radius outward~~



10-A child rotates a small stone using a string as shown in the figure. When the string is suddenly released, the body moves in.....

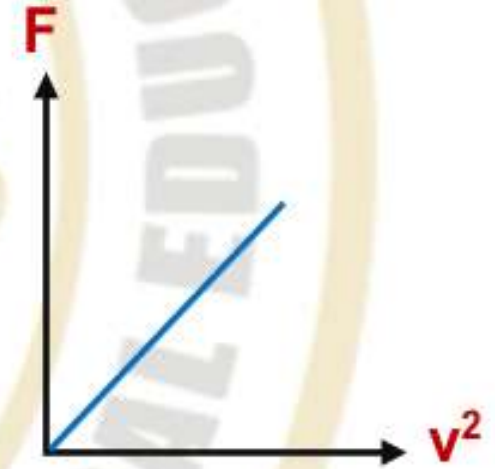
- A Direction A
- B) Direction B
- C) Direction C
- D) Direction D



11-The graph represents the relation between the centripetal force and the square of the tangential velocity.

The slope of the graph equals:

- A) $r \cdot m^2$
- B) $r \cdot m$
- C) m/r
- D) r/m



$$\text{slope} = \frac{F}{v^2} = \frac{m}{r}$$

$$F = \frac{mv^2}{r}$$

12. A body of mass 3 kg moves in a circular path of radius 10 m with a time period of π s. The magnitude of the centripetal force is

A) 15 N

B) 30 N

C) 60 N

D) 120 N

$$m = 3 \quad r = 10 \quad T = \pi \quad F_c =$$

$$v = \frac{2\pi r}{T} = 20 \text{ m/s}$$

$$F_c = \frac{mv^2}{r} = 120 \text{ N}$$

13. A man drives his car whose weight is $5 \times 10^4 \text{ N}$ in a circular path of radius 500 m with a tangential speed of 7.5 m/s.

If the frictional force is 571.5 N and $g = \underline{10 \text{ m/s}^2}$, then the mass of the man is ..

- A) 40 kg
- B) 58 kg
- C) 80 kg
- D) 800 kg

$$M = 5000 \text{ Kg}$$

$$r = 500 \quad \textcircled{m}$$

$$V = 7.5$$

$$F_c = 571.5$$

$$F_c = \frac{mv^2}{r}$$

$$M = 5080 \text{ Kg}$$

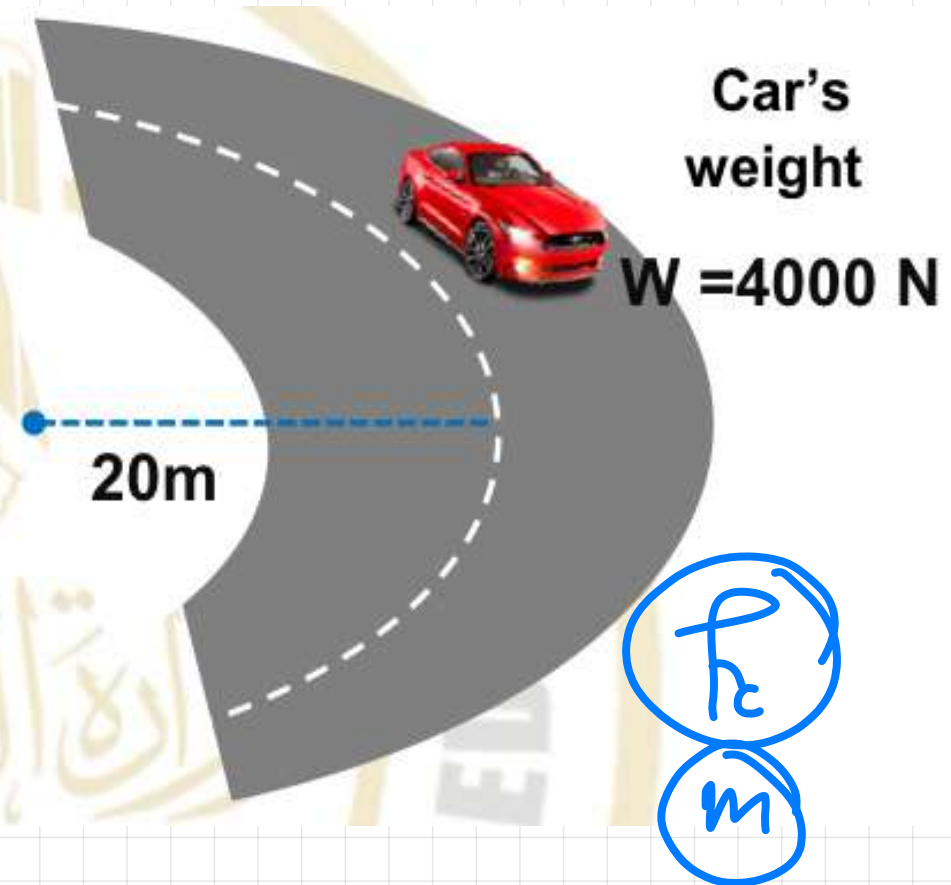
14. The car shown in the figure moves in a circular path. If the speed of the car is doubled while keeping the centripetal force constant, the car needs a path whose radius is the radius of the first path.

- A) Double
- B) One quarter
- C) Four times
- D) Half

$$N \rightarrow 2$$

$$\cancel{F} = \frac{mv^2}{r}$$

$$r \propto v^2 \rightarrow 2^2 \quad (4)$$



15. A car of mass 1000 kg moves in a circular field of radius 20 m .
If the maximum frictional force that the car tires can provide is 450 N ,
the maximum speed the driver must not exceed so that the car remains in the
circular path is

- A) 3 m/s
- B) 30 m/s
- C) 15 m/s
- D) 10 m/s

$$F_c = \frac{mv^2}{r}$$

$$V = 3 \text{ m/s}$$

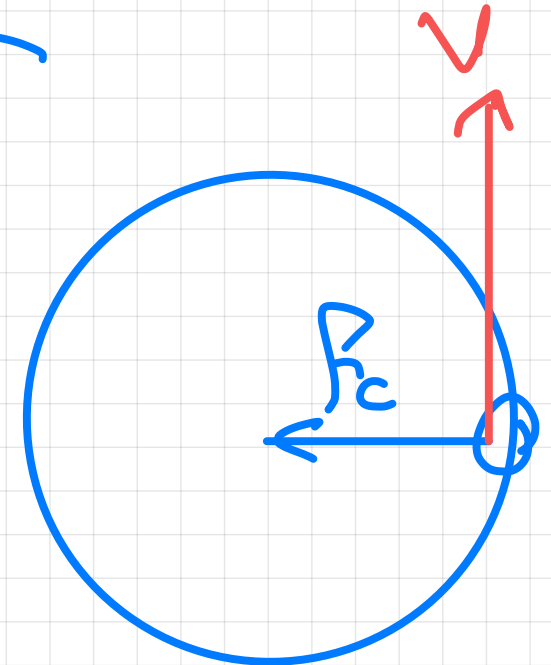
Second: Essay Questions

- 1) On rotating a stone attached to the end of a string in a circular path.
What is the direction of the force affecting on the stone? What is its benefit?
What is the direction of motion if the string is cut?
-

⊖ $F_c \rightarrow$ Center of C.P

⊖ Object moves in Circular Path

⊖ Object moves in straight line
Tangent to C.P



2- A car of mass 1000 kg is moving at a constant speed of 5 m/s in a curve of radius 50 m. Calculate centripetal friction force that keeps the car moving around the curve.

$$m = 1000$$

$$v = 5$$

$$r = 50$$

$$F_c = \frac{mv^2}{r} = 500\text{N}$$

$$r=40$$

3- A car of mass 750 kg moves in a circle of diameter 80 m. If the centripetal force acting on the car is 7500 N, find the speed of the car.

.....

.....

.....

.....

$$F_c = \frac{mv^2}{r}$$

$$v = 20 \text{ m/s}$$

4- An object of mass 0.01 Kg moves in a circular path of radius 150 cm if it takes 3 s to make a complete revolution, calculate magnitude & direction of the centripetal force.

.....

.....

.....

.....

$$T = \frac{t}{n} = \frac{3}{1} = 3 \text{ sec}$$

$$V = \frac{2\pi r}{T} = \pi \text{ m/s}$$

$$F_c = \frac{mv^2}{r} = 0.0657 \text{ N}$$

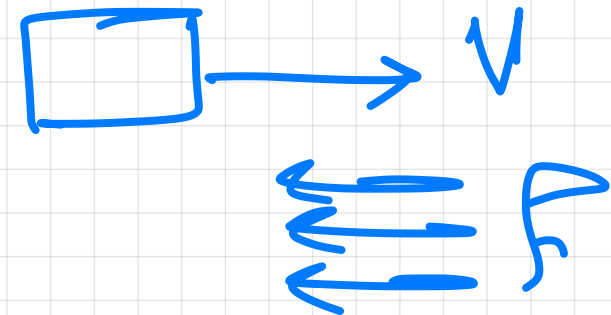
Center

Group (A)

First: Multiple Choice Questions

1-When a resultant force acts on a body moving with constant velocity in a direction opposite to its motion, the body's velocity

- ☒ a) Increases in magnitude and direction remains constant
- ☒ b) Decreases in magnitude and direction changes
- ☐ c) Decreases in magnitude and direction remains constant
- ☒ d) Increases in magnitude and direction changes

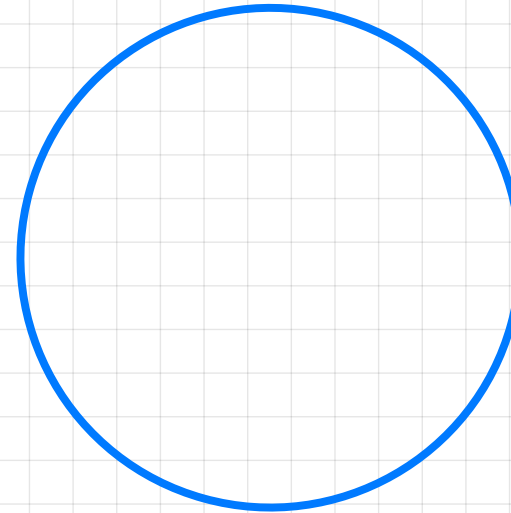


2. When a body moves in uniform circular motion, its velocity

- ~~A) Changes in magnitude and direction~~
- ~~B) Changes in magnitude and remains constant in direction~~
- C) Remains constant in magnitude but changes in direction**
- ~~D) Remains constant in both magnitude and direction~~

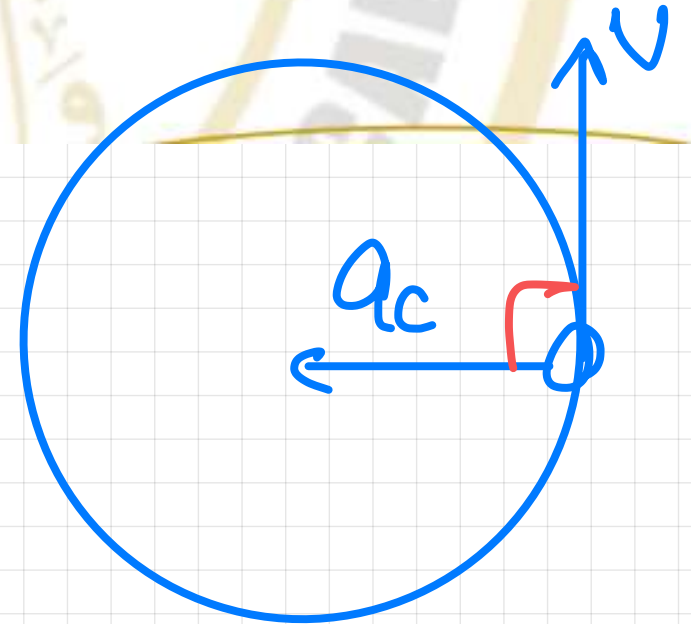


Variable



3. The angle between the centripetal acceleration and the instantaneous (tangential) velocity is

- A) 0°
- B) 45°
- C) 90°
- D) 180°



4. A ball tied to a string move in a horizontal circular path clockwise. If the string breaks at point (X), the ball moves

- ~~A) In a circular direction~~
- ~~B) Toward the west~~
- ~~C) Toward the east (along the tangent)~~
- D) Toward the south**



Second: Essay Questions

- 5- An object of 2 kg mass is tied to the end of a string to rotate in a horizontal circular path with a radius of 1.5 m making 3 revolutions in 9 s. Calculate:
(a) The linear (tangential) speed. (b) The tension force of the string on the body.

$$T = \frac{t}{n} = \frac{9}{3} = 3 \text{ Sec}$$

$$V = \frac{2\pi r}{T} = \frac{2\pi \times 1.5}{3} = \pi \text{ m/s}$$

$$F_c = \frac{mv^2}{r} = 13.16 \text{ N}$$



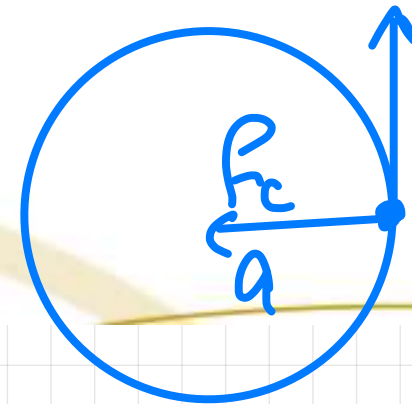
Group (B)

First: Multiple Choice Questions

1. When a body moves in uniform circular motion, the physical quantities remain constant except

- ~~A) The weight of the body~~
- B) The velocity vector**
- ~~C) The mass of the body~~
- ~~D) The uniform speed~~

①

 $\vec{F}_c$ $\vec{a}_c$ 

2. The centripetal acceleration of a body moving in a circular path increases when

- ~~a) The radius of the circular path increases~~
- ~~b) The mass of the body decreases~~
- c) The radius of the circular path decreases
- ~~d) The mass of the body increases~~

$$\uparrow a_c = \frac{v^2}{r}$$

Handwritten diagram showing the formula for centripetal acceleration. The acceleration a_c is indicated to increase with an upward red arrow. The velocity squared v^2 in the numerator is also indicated to increase with an upward red arrow. The radius r in the denominator is indicated to decrease with a downward red arrow.

3. A body of mass 5 kg moves in a circular path of radius 0.1 m and takes a time equal to π s to complete one revolution.

The centripetal force acting on the body equals N

A) 2

B) 6

C) 4

D) 8

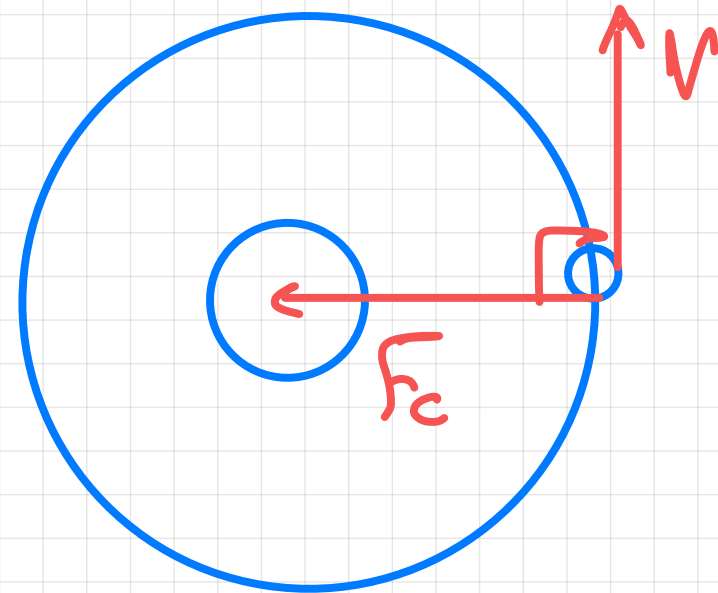
$$T = \frac{t}{n} = \frac{\pi}{1} = \pi$$

$$V = \frac{2\pi r}{T} = \frac{2\pi \times 0.1}{\pi} = 0.2 \text{ m/s}$$

$$F_c = \frac{mv^2}{r} = 2 \text{ N}$$

4. From the given figure, the Earth moves in its orbit around the Sun due to:

- ~~A) An attractive force in the same direction as the planets~~
- ~~B) An attractive force opposite to the direction of the Sun~~
- ~~C) An attractive force in the same direction as the Earth's motion~~
- D) An attractive force perpendicular to the direction of the Earth's motion**



Second: Essay Questions

5- A helicopter toy of mass 100 g flies in a circular path of radius 1 m and rotates at a rate of 100 revolutions in 20 sec. Calculate:

a) The linear (tangential) velocity of the toy.

b) The centripetal acceleration.

$$T = \frac{t}{n} = \frac{20}{100} = 0.2 \text{ Sec}$$

$$V = \frac{2\pi r}{T} = 10\pi \text{ m/s}$$

$$F_c = \frac{mV^2}{r} = 10\pi^2 \text{ N}$$

$$a_c = \frac{V^2}{r} = 100\pi^2 \text{ m/s}^2$$



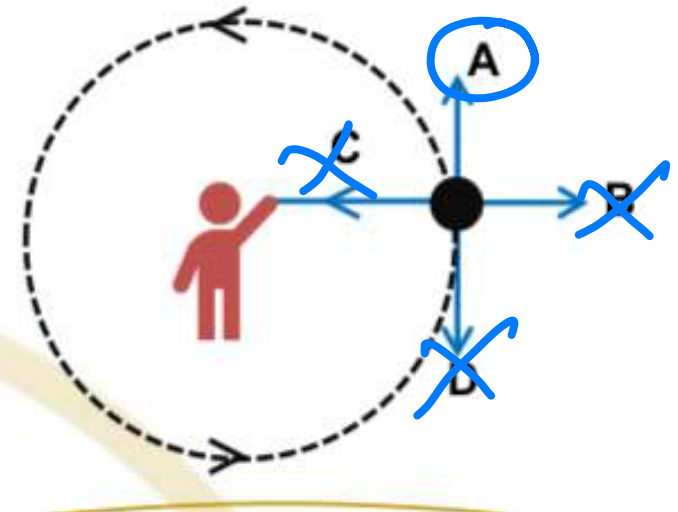
Group (C)

c) The centripetal force.

First: Multiple Choice Questions

1. A child rotates a small stone using a string as shown in the figure. When the string is suddenly released, the body moves in.....

- A) Direction A
- B) Direction B
- c) Direction C
- D) Direction D



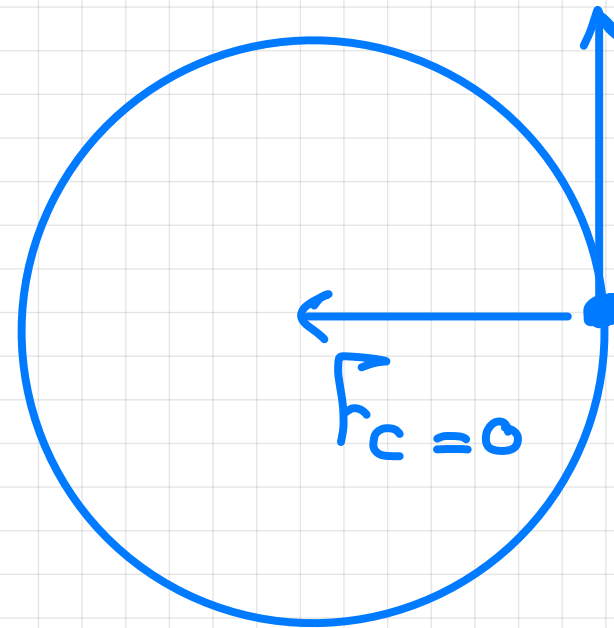
2. A body moves in a circular path and then moves along the tangent. The value of the force acting on it

A) Becomes zero

B) Doubles

C) Decreases to half

D) Does not change



3-A body of mass 2 kg moves in a circular path of radius 5 m with a tangential speed of 2 m/s. The magnitude of the centripetal force is

A) 0.2 N

B) 0.4 N

C) 1.6 N

D) 3.2 N

$$F_c = \frac{mv^2}{r} = 1.6 \text{ N}$$

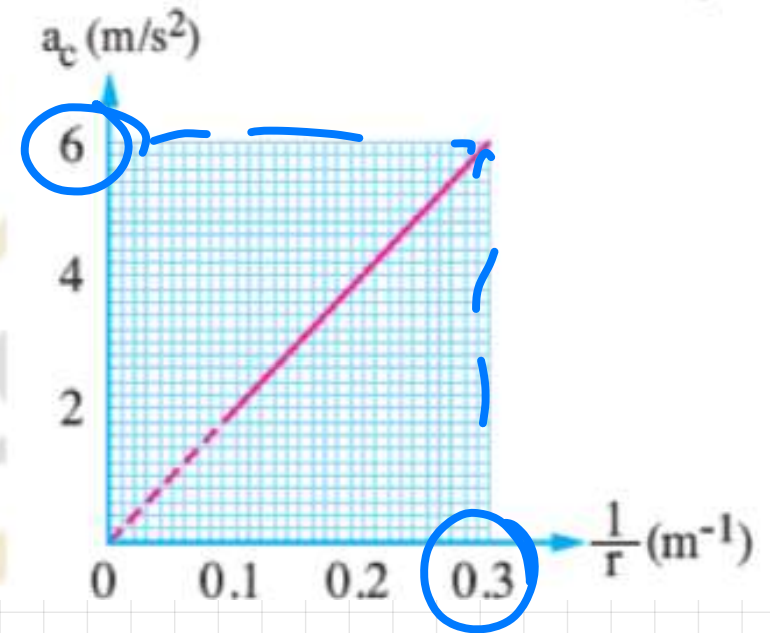
4..The opposite graph shows the relationship between the centripetal acceleration (a_c) with which a body moves in a horizontal circular path and the inverse of the radius of this path ($1/r$), then the tangential velocity with which the body moves equals

a) 4.47 m/s

b) 5.58 m/s

c) 3.13 m/s

d) 9.8 m/s



$$6 \leftarrow a_c = \frac{v^2}{r} = v^2 \times \left(\frac{1}{r} \right) \rightarrow 0.3$$

$$v = 4.47 \text{ m/s}$$

Second: Essay Questions

- 5) A car in amusement park of mass 200 kg moves in a circular path with velocity 10 m/s.
If the centripetal force acting on it 2000 N
Find: a) Radius of rotation. b) Centripetal acceleration.

$$F_c = \frac{mv^2}{r} \Rightarrow 2000 = \frac{200 \times 10^2}{r} \Rightarrow r = 10\text{m}$$

$$a_c = \frac{v^2}{r} = \frac{10^2}{10} = 10\text{ m/s}^2$$

$$a_c = \frac{F_c}{m} = \frac{2000}{200} = 10\text{ m/s}^2$$



Chapter 4| Factors affecting the centripetal force

First: Multiple Choice Questions

1. A body moves in a circular path. If the centripetal force becomes four times its original value, then the time period of the body will
- a) Decrease to one quarter
 - b) Double
 - c) Remain unchanged
 - d) Decrease to half
2. The following figure shows three cars (1), (2), (3) move in three horizontal curved paths with the same speed. If the masses of the cars are m , m , $3m$ in order, and the radii of their circular paths are d , $2d$, d In order, the correct ranking of these cars in terms of their susceptibility to skidding is



(1)



(2)



(3)

a) $2 < 1 < 3$

b) $1 < 2 < 3$

c) $3 < 1 < 2$

d) $3 < 2 < 1$

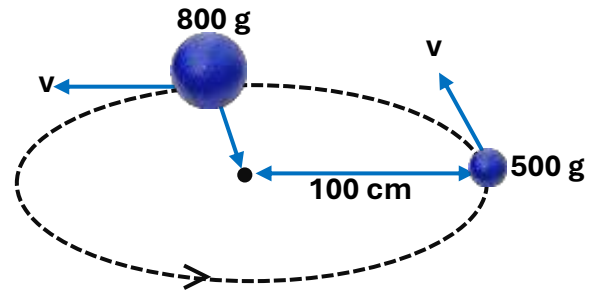
3. A child ties a stone of mass 300 g to a string and rotates it in a circular path of diameter 60 cm . If the maximum tension of the string can withstand is 4 N , the maximum speed of the stone without cutting the string is
- a) 2 m/s
 - b) 4 m/s
 - c) 6 m/s
 - d) 8 m/s



4. Two bodies of different masses move in the same circular path with the same speed as shown in the figure.

The ratio of the tension in the case of the smaller mass to the tension in the case of the larger mass is:

- a) Less than 1
- b) Equal to $1/2$
- c) Greater than 1
- d) Equal to 1



5. A body of weight 200 N moves in a circular path such that its speed is numerically equal to the radius ($V = r$), and $g = 10 \text{ m/s}^2$.

The centripetal force acting on the body equals N

- a) $2 V$
- b) $20 V$
- c) $200 V$
- d) $0.2 V$

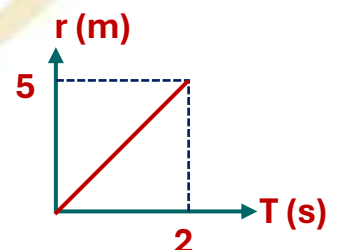
6. In a toy shop, a small airplane of mass 150 g is tied to a string of length 50 cm and completes three revolutions in 30 s. the tension force acting on the airplane is:

- A) $9.2 \times 10^{-2} \text{ N}$
- B) $2.9 \times 10^{-2} \text{ N}$
- C) $9.4 \times 10^{-2} \text{ N}$
- D) $4.9 \times 10^{-2} \text{ N}$

7. The adjacent graph shows the variation of the radius of a circular path with the time period for a body moving with constant centripetal acceleration.

From the graph data, the value of this acceleration is:

- A) 11.4 m/s^2
- B) 15.7 m/s^2
- C) 19.2 m/s^2
- D) 49.3 m/s^2





8-If a body moves in a circular path with linear speed (v) and time period (T), then its radius is reduced to one quarter while maintaining the same linear speed (v).

The new time period becomes:

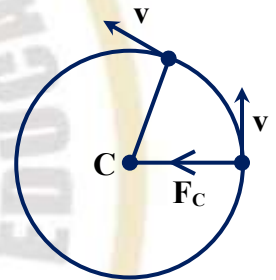
- A) $T/4$
- B) $4T$
- C) $T/2$
- D) $2T$

9-A body moves with a tangential speed $\frac{2\pi r}{T}$ in a circular path, where T is the time period. The centripetal acceleration of the body is equal to:

- A) $(2\pi r^2)/T^2$
- B) $(4\pi^2 r)/T^2$
- C) $(2\pi^2 r)/T^2$
- D) $(4\pi^2 r^2)/T^2$

10-When a body moves in a circular path of radius r and takes time T to complete one revolution, its centripetal force equals:

- A) $(4\pi^2 m r)/T$
- B) $(2\pi m r^2)/T^2$
- C) $(4\pi m r)/T$
- D) $(4\pi^2 m r)/T^2$



11-A body moves uniformly in a circular path with speed v , such that it completes three-quarters of a revolution in 6 s.

If its speed is doubled, the new time period becomes:

- A) 3 s
- B) 4 s
- C) 12 s
- D) 16 s

12-A body moves uniformly in a circular path of radius 4 m with centripetal acceleration 9 m/s^2 .

If its speed is doubled, the centripetal acceleration becomes:

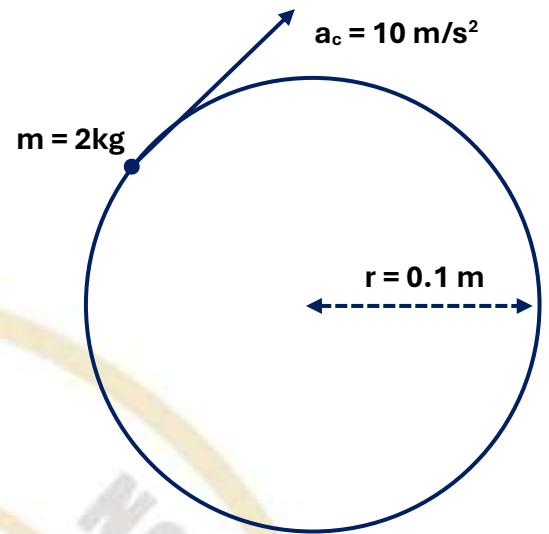
- A) 3 m/s^2
- B) 18 m/s^2
- C) 36 m/s^2
- D) 72 m/s^2



Second: Essay Questions

1-In the figure shown:

Calculate the velocity of the body and the centripetal force acting on it.



2-If the frictional force between the wheels of a motorcycle and the road is 4000 N, and its speed is 40 m/s, while the weight of the motorcycle and its rider is 1400 N:

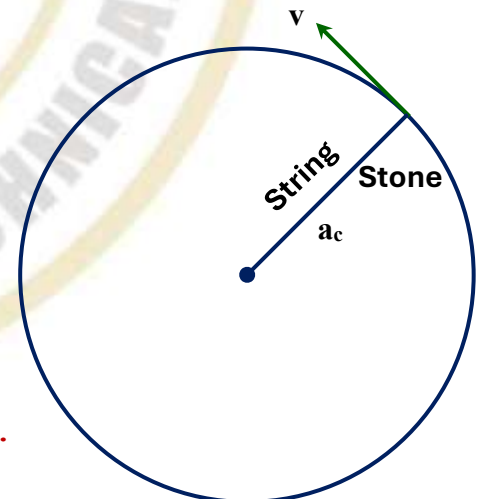
Calculate the radius of the road.

Given that $g = 10 \text{ m/s}^2$.



3-A stone is tied to the end of a string and moves in a circular path. If the length of the string is r , its speed is v , and its centripetal acceleration is a_c . If the speed of the stone is doubled while the radius remains constant:

Deduce the ratio between the second centripetal acceleration (a_{c2}) & the first centripetal acceleration (a_{c1}).





4- What is the scientific principle of:

- a) Drying clothes b) Making candy floss (cotton candy) c) Rotating barrel:

.....

5- Give reasons for:

- a) Although a body moving in a uniform circular motion is affected by a centripetal force towards the center, it never gets closer to the center of the circle.

.....

- b) At curves, the motorbike rider leans his bike and body towards the center of the circular path.

.....



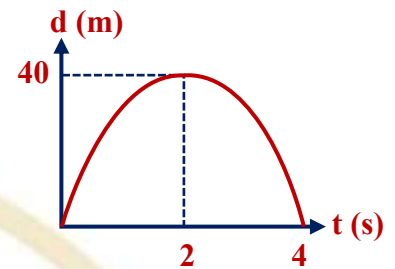
Group (B)

First: Multiple Choice Questions

1-A body moves uniformly along a circular path, and the adjacent graph shows the relation between its displacement and time.

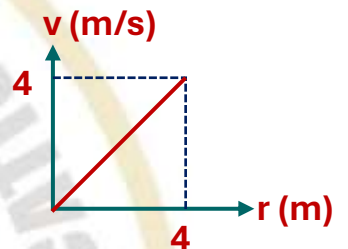
From the graph data, the centripetal acceleration is:

- A) 1.57 m/s^2 B) 25.2 m/s^2
C) 31 m/s^2 D) 49.3 m/s^2



2-The figure shows the graphical relation between the tangential speed of a body moving uniformly in a circular path and the radius of its path. From the graph, the centripetal acceleration when the radius is 4 m equals

- A) 1 m/s^2 B) 4 m/s^2
C) 8 m/s^2 D) 16 m/s^2



3-If the centripetal force acting on a body moving in a circle is increased to four times its original value, then to maintain its motion, the speed must

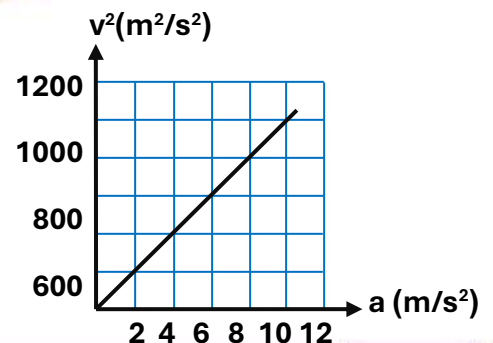
- A) Increase fourfold B) Decrease to one quarter
C) Double D) Decrease to half

4-When the centripetal force acting on a body moving in a circular path is doubled, its time period:

- A) Increases to $\sqrt{2}$ of its value B) Decreases to $1/\sqrt{2}$ of its value
C) Doubles D) Becomes four times

Second: Essay Questions

5-The graph shows the relationship between the centripetal acceleration (a_c) and the square of the tangential velocity (v^2) of a body moving in a circular path. Calculate the slope of the straight line.





First: Multiple Choice Questions

1-A body of mass 2 kg moves in a circular path of circumference 8π m, completing one revolution every π s. The magnitude of the centripetal force is

- A) 8 N
B) 8π N
C) 32 N
D) 16π N

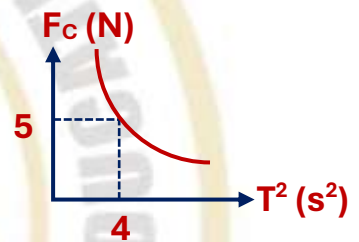
2-Two identical balls move in uniform circular motion with the same time period. If the radius of the first path is twice that of the second, the ratio of their centripetal forces respectively is

- A) $\frac{1}{2}$
B) $\frac{2}{1}$
C) $\frac{1}{1}$
D) $\frac{1}{4}$

3-The figure shows the relation between the centripetal force acting on a body of mass 0.5 kg and the square of its time period.

From the graph, the radius of the path is approximately:

- A) 1 m
B) 1.52 m
C) 2 m
D) 6.33 m



4-A body moves in a circular path. If the centripetal force is increased to four times its value, then the time period of the body

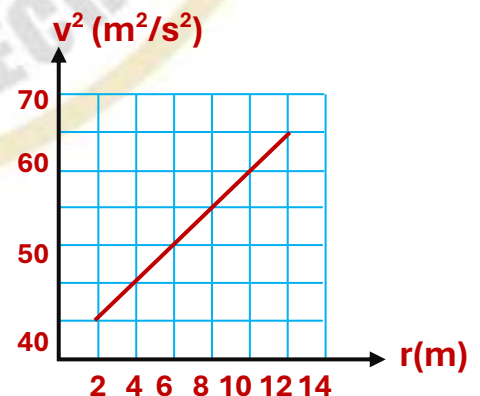
- A) Decreases to one quarter
B) Doubles
C) Remains unchanged
D) Decreases to half

Second: Essav Questions

5-A body of mass 4 kg moves along a path that contains different circular tracks.

A graph is drawn showing the relationship between the squares of different velocities of the body and the radii of the circular paths, as illustrated. From the graph, Calculate:

- a) The centripetal acceleration
b) The centripetal force



- The end -

First: Multiple Choice Questions

1. A body moves in a circular path. If the centripetal force becomes four times its original value, then the time period of the body will

- a) Decrease to one quarter
- b) Double
- c) Remain unchanged
- d) Decrease to half

$$T \quad F_c \rightarrow 4$$

$$F = \frac{mv^2}{r} \rightarrow (4)$$

$$v^2 = 4$$

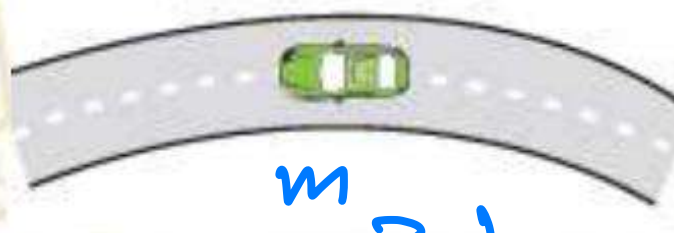
$$v = 2$$

$$v = \frac{2\pi r}{T} \rightarrow \frac{1}{2}$$

2. The following figure shows three cars (1), (2), (3) move in three horizontal curved paths with the same speed. If the masses of the cars are m , m , $3m$ in order, and the radii of their circular paths are d , $2d$, d in order, the correct ranking of these cars in terms of their susceptibility to skidding is



(1)

a) $2 < 1 < 3$ 

(2)

b) $1 < 2 < 3$ c) $3 < 1 < 2$ 

(3)

d) $3 < 2 < 1$

$$F_1 = \textcircled{1}$$

$$F_2 = \textcircled{\frac{1}{2}}$$

$$F_3 = \textcircled{3}$$

$$F_c = \frac{mv^2}{r}$$

3. A child ties a stone of mass 300 g to a string and rotates it in a circular path of diameter 60 cm. If the maximum tension of the string can withstand is 4 N, the maximum speed of the stone without cutting the string is

a) 2 m/s

b) 4 m/s

c) 6 m/s

d) 8 m/s

$$m = 0.3 \text{ Kg} \quad r = 0.3 \text{ m} \quad F_c = 4$$

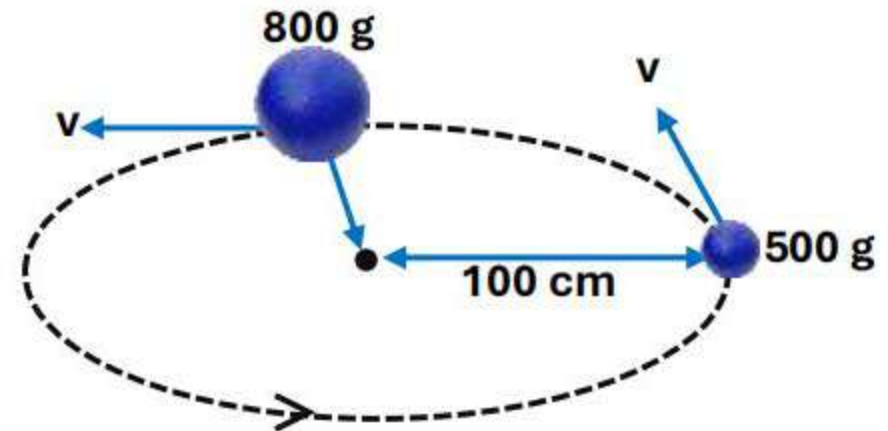
$$F_c = \frac{mv^2}{r}$$

$$v = 2 \text{ m/s}$$

4. Two bodies of different masses move in the same circular path with the same speed as shown in the figure.

The ratio of the tension in the case of the smaller mass to the tension in the case of the larger mass is:

- a) Less than 1
- b) Equal to 1/2
- c) Greater than 1
- d) Equal to 1



$$F = \frac{mv^2}{r}$$

$$\frac{v}{r}$$

$$\frac{P}{F} = \frac{m}{M} < 1$$

5. A body of weight 200 N moves in a circular path such that its speed is numerically equal to the radius ($V = r$), and $g = 10 \text{ m/s}^2$.

The centripetal force acting on the body equals N

- a) 2 V
- b) 20 V
- c) 200 V
- d) 0.2 V

$$W = mg \Rightarrow 200 = m \times 10 \Rightarrow m = 20 \text{ Kg}$$

$V = r$

$$F_c = \frac{mv^2}{r} = \frac{mV^{\cancel{2}}}{\cancel{V}}$$

$$F_c = mV = 20V$$

6-In a toy shop, a small airplane of mass 150 g is tied to a string of length 50 cm and completes three revolutions in 30 s. the tension force acting on the airplane is:

A) $9.2 \times 10^{-2} \text{ N}$

B) $2.9 \times 10^{-2} \text{ N}$

C) $9.4 \times 10^{-2} \text{ N}$

D) $4.9 \times 10^{-2} \text{ N}$

$$m = 0.15 \text{ Kg} \quad r = 0.5 \text{ m} \quad n = 3 \quad t = 30$$

$$T = \frac{t}{n} = \frac{30}{3} = 10 \text{ sec}$$

$$V = \frac{2\pi r}{T} = \pi/10 \text{ m/s}$$

$$F_c = \frac{mv^2}{r} = 2.9 \times 10^{-2} \text{ N}$$

7-The adjacent graph shows the variation of the radius of a circular path with the time period for a body moving with constant centripetal acceleration.

From the graph data, the value of this acceleration is:

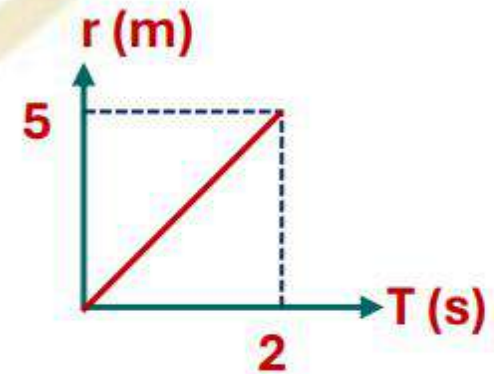
A) 11.4 m/s^2

B) 15.7 m/s^2

C) 19.2 m/s^2

D) 49.3 m/s^2

$$r = 5 \quad T = 2$$



$$V = \frac{2\pi r}{T} = 5\pi \text{ m/s}$$

$$a_c = \frac{V^2}{r} = 49.3 \text{ m/s}^2$$

8-If a body moves in a circular path with linear speed (v) and time period (T), then its radius is reduced to one quarter while maintaining the same linear speed (v).

The new time period becomes:

A) $T/4$

B) $4T$

C) $T/2$

D) $2T$

$$r = \frac{1}{4}$$



$$\cancel{v} = \frac{\cancel{2\pi r} \rightarrow \frac{1}{4}}{\cancel{T} \rightarrow \frac{1}{4}}$$

9- A body moves with a tangential speed $\frac{2\pi r}{T}$ in a circular path, where T is the time period. The centripetal acceleration of the body is equal to:

A) $(2\pi r^2)/T^2$

B) $(4\pi^2 r)/T^2$

C) $(2\pi^2 r)/T^2$

D) $(4\pi^2 r^2)/T^2$

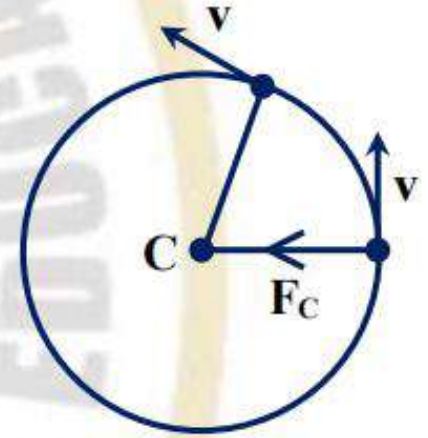
$$a_c = \frac{v^2}{r}$$

$$v = \frac{2\pi r}{T}$$

$$a_c = \frac{(2\pi r)^2}{T^2 r} = \frac{4\pi^2 r^2}{\cancel{r} T^2} = \frac{4\pi^2 r}{T^2}$$

10-When a body moves in a circular path of radius r and takes time T to complete one revolution, its centripetal force equals:

- A) $(4\pi^2 m r)/T$
- B) $(2\pi m r^2)/T^2$
- C) $(4\pi m r)/T$
- D) $(4\pi^2 m r)/T^2$



$$F_c = m a_c = \frac{m 4\pi^2 r}{T^2}$$

11 - A body moves uniformly in a circular path with speed v , such that it completes three-quarters of a revolution in 6 s.

If its speed is doubled, the new time period becomes:

- A) 3 s
- B) 4 s
- C) 12 s
- D) 16 s

$$n = 0.75 \quad t = 6$$

$$V \rightarrow 2$$

$$T = \frac{t}{n} = \frac{6}{0.75} = 8 \text{ sec}$$

$$\textcircled{2} \leftarrow V = \frac{\cancel{2\pi r}}{T \rightarrow \textcircled{\frac{1}{2}}}$$

12-A body moves uniformly in a circular path of radius 4 m with centripetal acceleration 9 m/s^2 .

If its speed is doubled, the centripetal acceleration becomes:

A) 3 m/s^2

B) 18 m/s^2

C) 36 m/s^2

D) 72 m/s^2

$$r = 4 \quad a_c = 9 \quad v \rightarrow 2$$

$$a_c = \frac{v^2}{r}$$

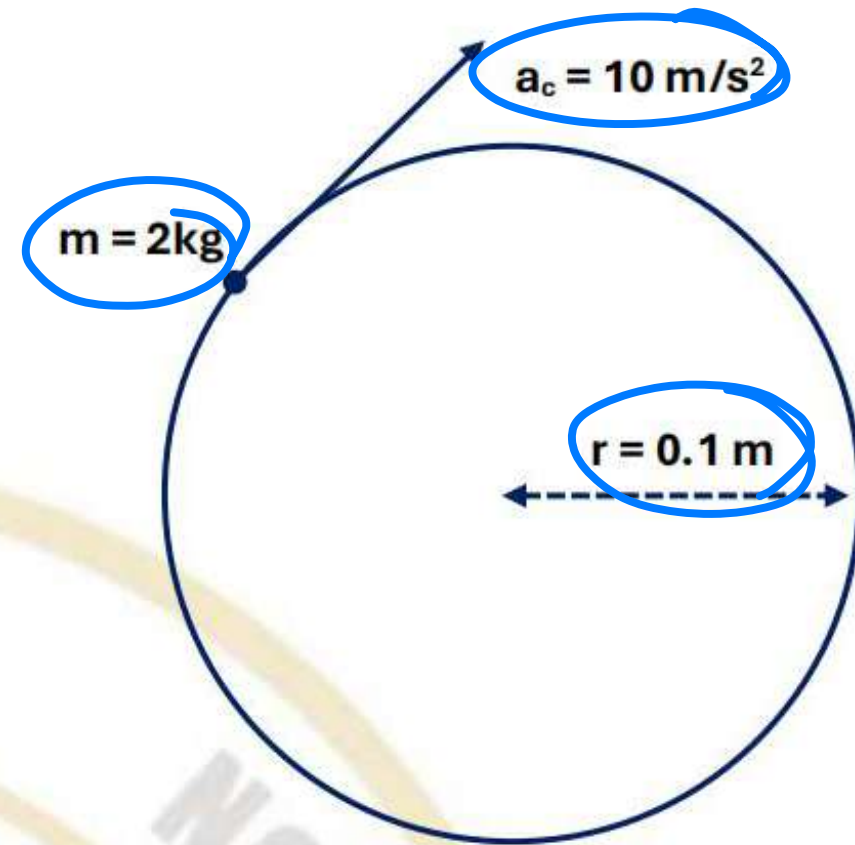
$$9 \leftarrow \frac{a_{c1}}{a_{c2}} = \frac{v_1^2}{v_2^2}$$

$$36$$

Second: Essay Questions

1-In the figure shown:

Calculate the velocity of the body and the centripetal force acting on it.



$$a_c = \frac{v^2}{r}$$

$$10 = \frac{v^2}{0.1} \Rightarrow v = 1 \text{ m/s}$$

$$F_c = m a_c = 2 \times 10 = 20 \text{ N}$$

2-If the frictional force between the wheels of a motorcycle and the road is 4000 N, and its speed is 40 m/s, while the weight of the motorcycle and its rider is 1400 N:

Calculate the radius of the road.

Given that $g = 10 \text{ m/s}^2$.

$r = ?$



$$F_c = 4000 \quad V = 40 \quad W = mg$$

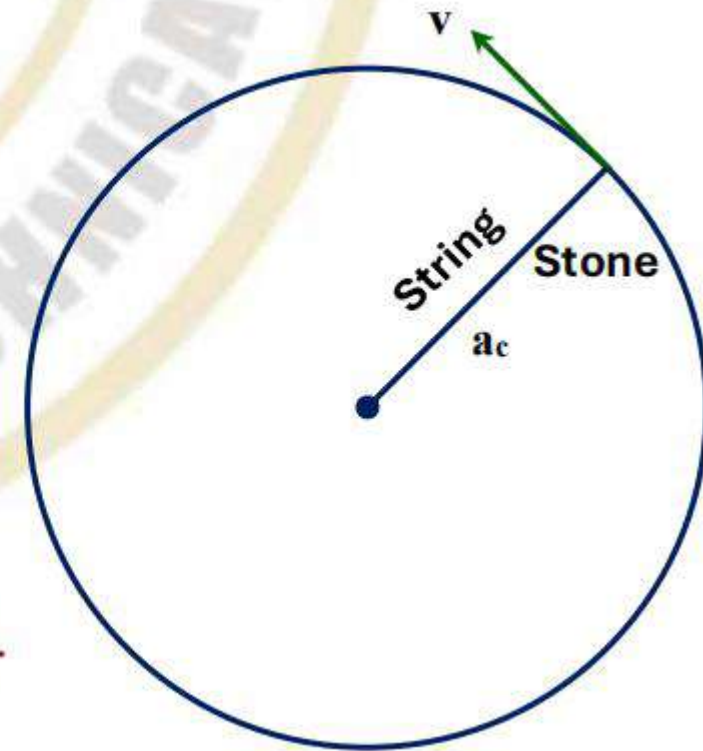
$$F_c = \frac{mv^2}{r} \rightarrow 56 \text{ m}$$

$$1400 = m \times 10$$

$$m = 140 \text{ kg}$$

3-A stone is tied to the end of a string and moves in a circular path. If the length of the string is r , its speed is v , and its centripetal acceleration is a_c . If the speed of the stone is doubled while the radius remains constant:

Deduce the ratio between the second centripetal acceleration (a_{c2}) & the first centripetal acceleration (a_{c1}).



$$a_c = \frac{v^2}{r} \quad a_c \leftarrow \frac{a_{c1}}{a_{c2}} = \frac{v_1^2 \rightarrow v^2}{v_2^2 \rightarrow 4v^2}$$

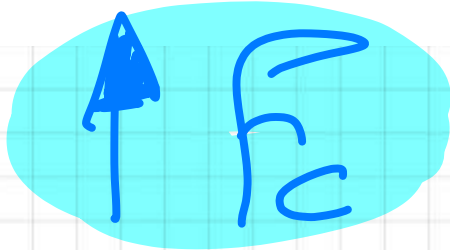
$$a_{c2} = 4a_c$$

4- What is the scientific principle of:

a) Drying clothes

b) Making candy floss (cotton candy)

c) Rotating barrel:

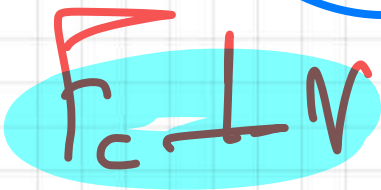
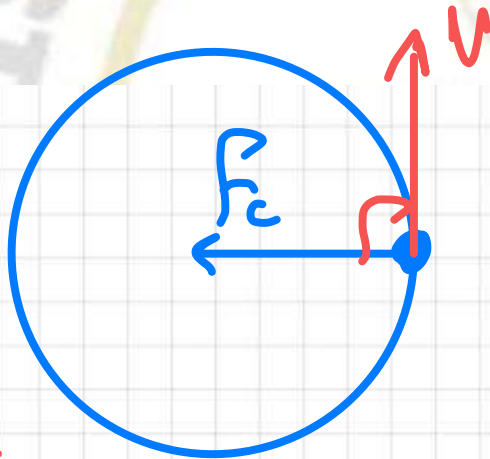


5- Give reasons for:

a) Although a body moving in a uniform circular motion is affected by a centripetal force towards the center, it never gets closer to the center of the circle.

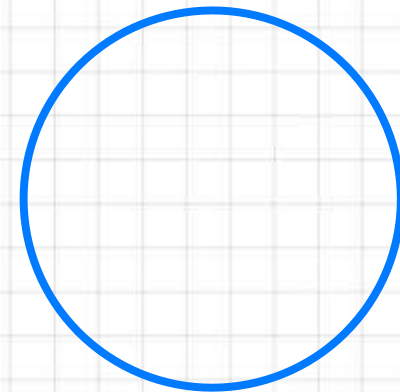
b) At curves, the motorbike rider leans his bike and body towards the center of the circular path.

(a)



(b)

To maintain F_c



Group (A)

First: Multiple Choice Questions

1 - A body moves uniformly along a circular path of radius 20 m, completing one-quarter of a revolution every minute. The time period is:

A) 0.25 s

B) 4 s

C) 120 s

D) 240 s

$$r = 20 \quad n = \frac{1}{4} \quad t = 60 \quad T =$$

$$T = \frac{t}{n} = \frac{60}{\frac{1}{4}} = 240 \text{ Sec}$$

2-A body moves uniformly in a circular path of circumference 628 m, completing one-quarter of a revolution every 2 s.

Its tangential speed is:

A) 6.28 m/s

B) 78.5 m/s

C) 157 m/s

D) 314 m/s

$$2\pi r = 628 \rightarrow r = 100\text{m}$$

$$n = \frac{1}{4} \quad t = 2 \quad T = 8\text{sec}$$

$$V = \frac{2\pi r}{T} = 78.5\text{m/s}$$

3- A body moves uniformly in a circular path such that the displacement for each quarter revolution is $7\sqrt{2}$ m after 1.5 s. The centripetal acceleration is

A) 1.04 m/s^2

B) 2.08 m/s^2

C) 7.66 m/s^2

D) 46.01 m/s^2

$$n = \frac{1}{4} \quad t = 1.5$$

$$r^2 + r^2 = (7\sqrt{2})^2$$

$$2r^2 = 98$$

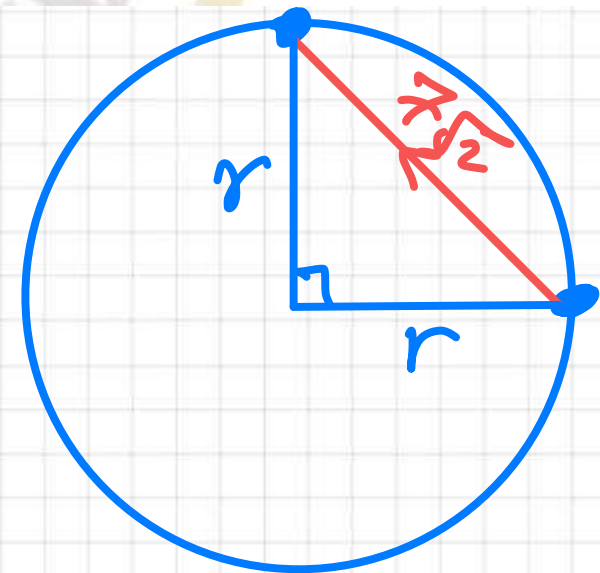
$$r = 7 \text{ m}$$

$$T = 6 \text{ sec}$$

$$V = \frac{2\pi r}{T}$$

$$V = 7.33 \text{ m/s}$$

$$a_c = \frac{V^2}{r} = 7.67 \text{ m/s}^2$$



4-A body of mass 1 kg moves in a circular path of radius 45 cm under the effect of a centripetal force of 36 N. The time required to complete 40 revolutions is

A) π s

B) 2π s

C) 4π s

D) 9π s

$$m = 1$$

$$r = 0.45$$

$$F = 36$$

$$n = 40 \quad t =$$

$$F_c = \frac{mv^2}{r}$$

$$v = 4 \text{ m/s}$$

$$v = \frac{2\pi r}{T}$$

$$T = 0.7 \text{ sec}$$

$$T = \frac{9\pi}{40}$$

$$t = T \cdot n$$

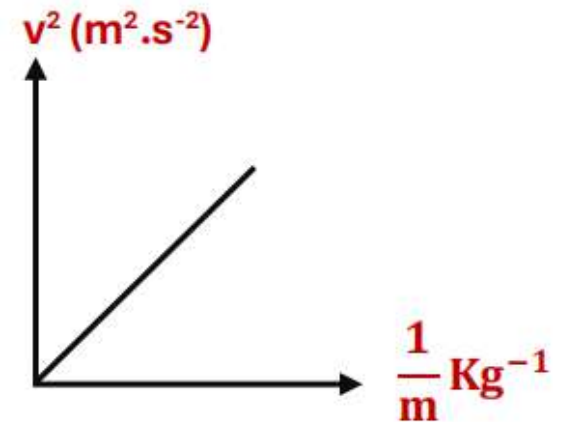
$$t = 28 \text{ sec}$$

$$t = \frac{9}{40} \pi \times 40$$
$$9\pi \text{ sec}$$

Second: Essay Questions

5-The graph shows the relationship between the square of the velocity (v^2) and the reciprocal of the mass ($1/m$).

Deduce the unit of the slope.



$$\text{Slope} = \frac{v^2}{\frac{1}{m}} = v^2 m$$

$$\text{Slope} = \underline{F_c r} = m v^2$$

$$\begin{aligned} \text{N.m} &= \text{Kg} \cdot \text{m} \cdot \text{s}^{-2} \cdot \text{m} \\ &= \text{Kg} \cdot \text{m}^2 \cdot \text{s}^{-2} \end{aligned}$$

$$F_c = \frac{m v^2}{r}$$

$$F = mg$$

$$N = \text{Kg} \cdot \text{m} \cdot \text{s}^{-2}$$

Group (B)

First: Multiple Choice Questions

1 - A body moves uniformly along a circular path, and the adjacent graph shows the relation between its displacement and time.

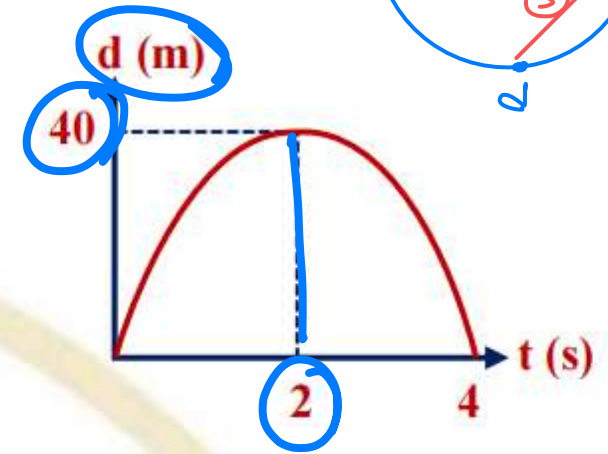
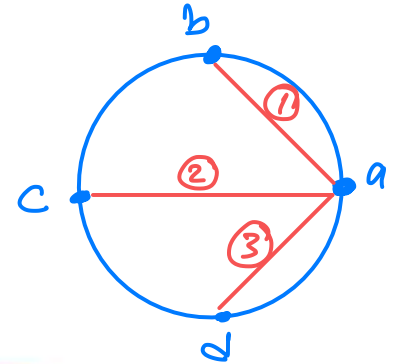
From the graph data, the centripetal acceleration is:

A) 1.57 m/s^2

B) 25.2 m/s^2

C) 31 m/s^2

D) 49.3 m/s^2



$$d = 40 \rightarrow r = 20 \text{ m}$$

$$n = \frac{1}{2} \quad t = 2 \quad T = 4 \text{ Sec}$$

$$V = \frac{2\pi r}{T} = 10\pi$$

$$a_c = \frac{V^2}{r}$$

$$a_c = 49.38 \text{ m/s}^2$$

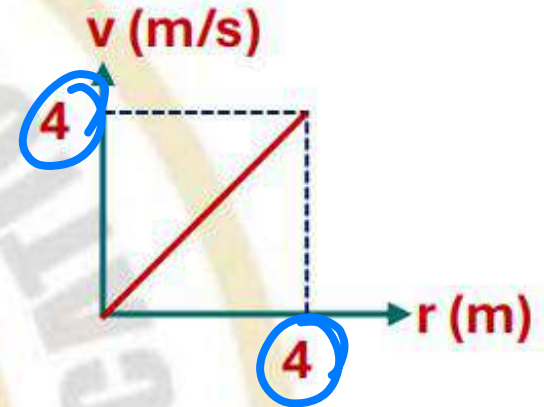
2-The figure shows the graphical relation between the tangential speed of a body moving uniformly in a circular path and the radius of its path. From the graph, the centripetal acceleration when the radius is 4 m equals

A) 1 m/s^2

B) 4 m/s^2

C) 8 m/s^2

D) 16 m/s^2



$$v=4 \quad r=4$$

$$a_c = \frac{v^2}{r} = \frac{4^2}{4} = 4 \text{ m/s}^2$$

3-If the centripetal force acting on a body moving in a circle is increased to four times its original value, then to maintain its motion, the speed must

A) Increase fourfold

B) Decrease to one quarter

C) Double

D) Decrease to half

$$F_c \rightarrow 4$$

$$V = 2$$

$$\textcircled{4} \leftarrow F_c = \frac{\cancel{m} v^2}{\cancel{r}} \rightarrow \textcircled{4}$$

$$V^2 = 4$$

$$V = 2$$

4-When the centripetal force acting on a body moving in a circular path is doubled its time period:

~~A) Increases to $\sqrt{2}$ of its value~~

~~C) Doubles~~

B) Decreases to $1/\sqrt{2}$ of its value

~~D) Becomes four times~~

$$F_c \rightarrow 2$$

$$\textcircled{2} \leftarrow F_c = \frac{m \cancel{v^2} \rightarrow 2}{\cancel{r}}$$

$$v^2 = 2$$

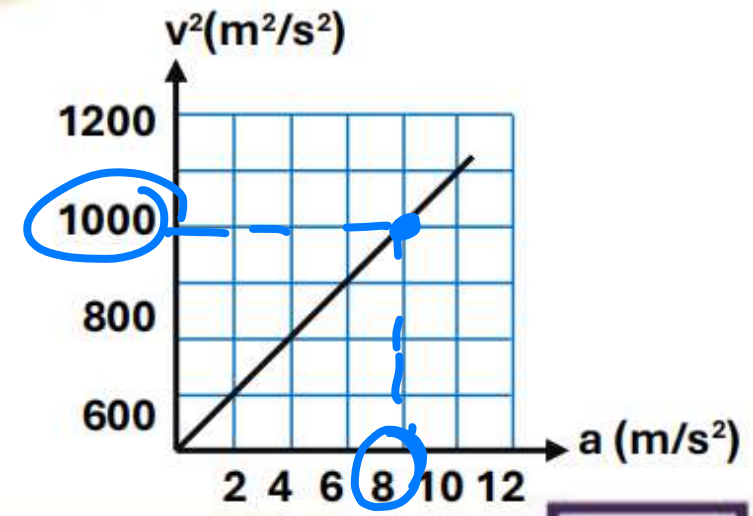
$$v = \sqrt{2}$$

$$\textcircled{v} = \frac{2\pi r}{\textcircled{T}} \rightarrow \frac{1}{\sqrt{2}}$$

Second: Essay Questions

5-The graph shows the relationship between the centripetal acceleration (a_c) and the square of the tangential velocity (v^2) of a body moving in a circular path.

Calculate the slope of the straight line.



$$a_c = \frac{v^2}{r}$$

$$8 = \frac{1000}{r}$$

$$r = 125\text{m}$$

$$\text{Slope} = \frac{v^2}{a_c} = r = 125\text{m}$$

First: Multiple Choice Questions

1 - A body of mass 2 kg moves in a circular path of circumference 8π m, completing one revolution every π s. The magnitude of the centripetal force is

A) 8 N

C) 32 N

B) 8π ND) 16π N

$$m = 2$$

$$\cancel{2\pi} r = \cancel{8\pi} \rightarrow \boxed{r = 4 \text{ m}} \quad T = \pi$$

$$v = \frac{2\pi r}{T} = \frac{\cancel{2\pi} \times 4}{\cancel{\pi}} = 8 \text{ m/s}$$

$$F_c = \frac{mv^2}{r} = 32 \text{ N}$$

2- Two identical balls move in uniform circular motion with the same time period.

If the radius of the first path is twice that of the second, the ratio of their centripetal forces respectively is

A) $\frac{1}{2}$

C) $1/1$

B) $2/1$

D) $1/4$



$$r = 2$$

$$r = 1$$

$$v = \frac{2\pi r}{T}$$

$$F_c = \frac{mv^2}{r}$$

$$F_c \propto r$$

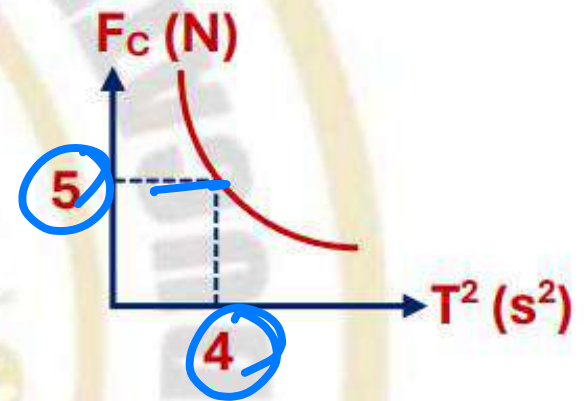
$$\frac{F_{c1}}{F_{c2}} = \frac{r_1}{r_2} = \frac{2}{1}$$

3-The figure shows the relation between the centripetal force acting on a body of mass 0.5 kg and the square of its time period.

From the graph, the radius of the path is approximately:

- A) 1 m
C) 2 m

- B) 1.52 m
D) 6.33 m



$$F_c = \frac{mv^2}{r} = \frac{m [2\pi r]^2}{r T^2}$$

$$F_c = \frac{m 4\pi^2 r}{T^2} \rightarrow 1.013m$$

$$\begin{aligned} F_c &= 5 \\ T^2 &= 4 \\ T &= 2 \\ m &= \frac{1}{2} \end{aligned}$$

4- A body moves in a circular path. If the centripetal force is increased to four times its value, then the time period of the body

~~A) Decreases to one quarter~~
~~C) Remains unchanged~~

~~B) Doubles~~

D) Decreases to half

$$F_c \rightarrow 4$$

$$F_c = \frac{m 4\pi^2 r}{T^2}$$

$$\frac{1}{4} = \frac{F_{c1}}{F_{c2}} = \frac{T_2^2}{T_1^2}$$

$$T_2^2 = \frac{1}{4}$$

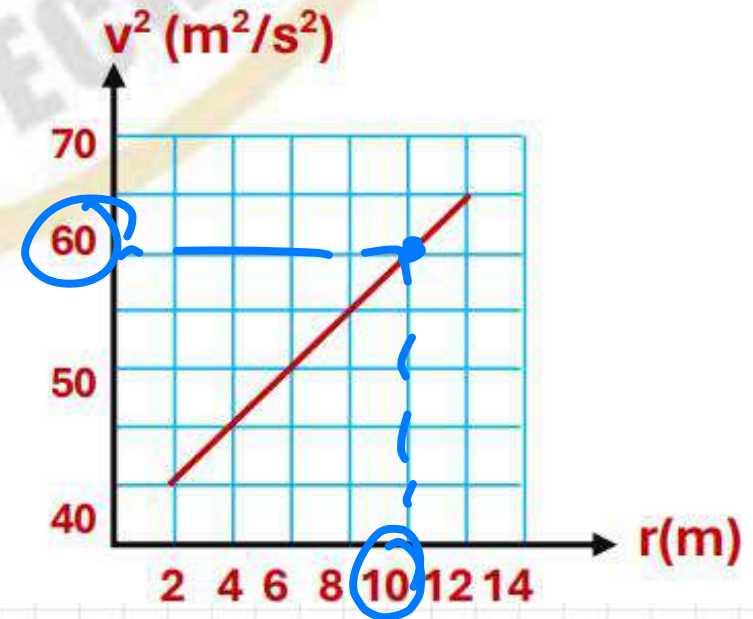
$$T_2 = \frac{1}{2}$$

Second: Essay Questions

5- A body of mass 4 kg moves along a path that contains different circular tracks.

A graph is drawn showing the relationship between the squares of different velocities of the body and the radii of the circular paths, as illustrated. From the graph, Calculate:

- The centripetal acceleration
- The centripetal force



$$V^2 = 60 \quad r = 10$$

$$a_c = \frac{V^2}{r} = \frac{60}{10} = 6 \text{ m/s}^2$$

$$F_c = m a_c = 4 \times 6 = 24 \text{ N}$$

كيفية طباعة صفحات معينة من ملف معين مثلا ازاي نطبع الصفحات من صفحة 4 الى صفحة 9

